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PALEOBOTANY.—*Temperate species in the Eocene flora of the southeastern United States.*[1] ROLAND W. BROWN, U. S. Geological Survey.

The Eocene flora of the southeastern United States, collected from sediments deposited along the ancient, coastal margin of the land, has been interpreted as a subtropical, chiefly strand, lagoon, and bayou flora. This conclusion is inferred from the character of its composition, which included types of ferns, palms, and dicotyledons, whose living counterparts or relatives are adapted to life at or near sea level in the tropics and subtropics. Roughly 80 per cent of the dicotyledons had leaves with entire margins, confirming, according to the Bailey and Sinnott (1915) formula, the interpretation based on composition. "There is not a single strictly temperate type in the whole assemblage," says Berry (1916, p. 136), "the nearest approach to such types being the genera *Juglans*, *Myrica*, *Magnolia*, *Cercis*, *Ilex*, *Nyssa*, and *Fraxinus*.

The purpose of this paper is not to dispute the general conclusion just stated but to call attention to some specimens that I believe have hitherto been misidentified and that may have originated from trees growing under temperate conditions inland from the coast, perhaps along streams in the foothills of the Eocene Appalachians. These relatively rare specimens include species of *Fagus*, *Sassafras*, and *Staphylea*. Other genera, with temperate rather than subtropical implications, are listed in the Eocene column of Table 7 in Cain's (1943) paper discussing the Tertiary aspect of the present temperate forests of the Great Smoky Mountains National Park. Many of these genera are represented only by fragmentary leaves, fruits, or seeds, and their identifications at best are largely conjectural. Of *Salix*, *Quercus* (except *Dryophyllum*), *Celtis*, and *Platanus* (of the *occidentalis* type) I find no authentic fossil record, and the leaf called *Cercis wilcoxiana* Berry represents *Cercidiphyllum arcticum* (Heer) Brown. The presence of *Cladrastis*, *Prunus*, *Ilex*, *Aralia*, and *Cornus* is, it seems to me, based on specimens that need further confirmation before they can be cited as reliable evidence of the existence of those genera in the Eocene flora of the southeastern States.

Despite these criticisms all the temperate genera listed by Cain were most likely present in the Eocene inland and upland forest. Their absence from the fossil record may be explained by their having lived on sites unfavorable to the preservation of their remains, and to the destruction of such remains before reaching suitable sedimentary basins near the coast. Even so, an occasional fortunate accident may have preserved a leaf or a seed that now awaits discovery by more thorough search of the fossil-bearing strata.

Whether a Tertiary flora may be adjudged subtropical or temperate depends upon a sane application of the assumption that, in general, Tertiary species had habitat and climatic requirements similar or nearly similar to their modern equivalents. The critical point here, of course, is the accurate determination of the existing equivalents, if any; for, even if fossils are correctly identified generically, the misidentification of their specific living equivalents may lead to erroneous conclusions as to habitat and climate. The modern North

[1] Published by permission of the Director, Geological Survey, U. S. Department of the Interior. Received June 19, 1944.

American correlatives of the fossil species about to be treated are wide-ranging in the temperate zone, but none reaches the Tropic of Cancer except species of *Acer*, *Carpinus*, and *Staphylea* at moderate to high altitudes in Mexico and Central America. These, however, can hardly be called indicative or representative of a subtropical climate in the ordinary sense.

In a previous paper (Brown, 1940, p. 351) I discussed *Acer knowltoni* (Berry) Brown from Eocene deposits near Somerville, Fayette County, Tenn. This maple is represented by asymmetric leaflets and characteristic samaras, which suggest comparison with the living boxelder maple, *Acer negundo* Linnaeus. Moreover, these fossils are associated with those hereinafter described as *Staphylea splendens* (Berry) Brown just as their living counterparts may be found associated today, thus strengthening the conviction that a maple of the *negundo* type is correctly identified as present in that Eocene flora. The absence of authentic Salicaceae and Betulaceae from the Eocene floras of the southeastern States would seem inexplicable if other predominantly temperate genera like *Acer*, *Sassafras*, and *Staphylea* were present. In 1942, however, in a collection made by F. S. MacNeil, of the U. S. Geological Survey, on the Taylor farm, Chester County, Tenn., I found well-preserved portions of betulaceous leaves having the pinnate secondary venation and the doubly serrate or serrulate margin characteristic of most Betulaceae. Examples of other missing temperate genera will doubtless be found as collectors become aware of the possibilities.

Fagus aspera (Berry) Brown, n. comb.

Diospyros asper Berry, U. S. Geol. Survey Prof. Paper 156: 127, pl. 25, fig. 32. 1930.

In 1937 I found several more specimens of the kind described by Berry as calyces of *Diospyros asper* at the same locality on Mill Creek, Hardeman County, Tenn. These fossils received the specific name *asper* because their outer surface is conspicuously roughened by pointed, short prickles or papillae. Although *D. asper* was compared with the calyces of *D. lanceolata* Roxburgh, from India, and with a fossil, *D. rugosa* Saporta, from the Oligocene of southeastern France, the comparisons upon closer inspection fail to be convincing. The rugosity of the living and fossil species cited consists chiefly of cross-wrinkles or striae and not of papillae. No living species of *Diospyros*, so far as I am aware, has calyces with papillose rugosity. On the other hand, the fossils can be matched very well with the 4-parted burs of *Fagus*.

Associated with these likely burs of *Fagus* are leaves hitherto called *Dryophyllum tenneseensis* Berry. There seems to be no doubt that these leaves belong to the Fagaceae, but they are sufficiently different from those of living species of *Fagus* to arouse caution before assigning them to that genus. The leaves, moreover, have been found abundantly at other localities where no burs of *Fagus* have yet been taken. Consequently, more exploration seems indicated before a conclusion can be reached as to the organic relationship of the leaves and burs.

Occurrence.—On Mill Creek, Hardeman County, Tenn.

Sassafras suspectum Brown, n. sp.

Sterculia wilcoxensis Berry, U. S. Geol. Survey Prof. Paper 156: 107, pl. 26; pl. 27, fig. 5 [not other references]. 1930.

The leaves referred to here, described and illustrated by Berry, despite general resemblances seem to me to differ in important respects from the remainder hitherto synonymized with *Sterculia wilcoxensis*. The latter have wide, open sinuses between the relatively narrow, pointed lobes, and the midveins of the lateral lobes display a tendency to spread away from rather than to converge toward the apex. I can match the former easily by leaves from *Sassafras;* but I know of no living leaves that compare readily with the latter. If these also are *Sassafras* they should be kept distinct from the former.

These leaves are somewhat larger than those of the Tertiary species described from the northwestern States. In general appearance they also resemble some leaves of *Artocarpus pungens* (Lesquereux) Hollick, but the lobes of the latter are sharp-pointed.

Occurrence.—Railroad cut at Pine Top, Hardeman County, Tenn.

Staphylea splendens (Berry) Brown, n. comb.

Euonymus splendens Berry, U. S. Geol. Survey Prof. Paper 91: 267, pl. 61, fig. 6; pl. 62, figs. 1–5. 1916.

Hicoria crescentia Knowlton. Berry, U. S. Geol. Survey Prof. Paper 156: 59, pl. 34, figs. 1–5. 1930.

The first specimens described as *Euonymus splendens* were single detached leaves which aroused no suspicions of their being leaflets, although the describer noted that they were slightly inequilateral and bore some resemblance to *Hicoria antiquorum* (Newberry) Knowlton. In 1930, Berry reported compound leaves from Somerville, Tenn., as *Hicoria crescentia* Knowlton, on the basis of resemblance to a very fragmentary specimen described by Knowlton from Eocene strata in Yellowstone National Park. Whether Knowlton's specimen was correctly identified even generically is a moot question, but the leaflets of the Berry specimens of both species, as may be seen by comparing the illustrations, resemble one another so closely that I venture to believe they represent but one species.

In 1937 I visited Grand Junction and Somerville, Tenn., the chief localities from which the Berry specimens came and made collections containing additional material which convinces me that these specimens need reallocation. The outstanding facts about the compound leaves are that all are trifoliate, and all the leaflets have relatively long petiolules. Neither of these facts harmonizes with the assignment of the leaves to *Euonymus* or *Hicoria*, but they are consonant with an interpretation as *Staphylea*.

Unfortunately, none of the characteristic bladdery pods of *Staphylea* has yet been found in the Tennessee localities to confirm this identification. Collectors should be on the alert for them.

This species resembles closely *Staphylea acuminata* Lesquereux (1878, p. 267, pl. 48, figs. 4, 5) from the lake beds at Florissant, Colo., but in the Florissant specimens the petiolules of the side leaflets are very short, thus harmonizing more closely with the existing species, *S. trifolia* Linnaeus, of the eastern United States.

In general form, venation, and marginal dentition these leaves are similar to some called *Euonymus glandiferus* Ball (1931, p. 85, pl. 6, figs. 1, 2, 4; pl. 7, fig. 1) from the Indio formation of Texas. The latter, however, differ uniquely in having prominent glands in the angles made by the secondary veins with the midvein and about 5 mm from the midvein. At present I have no opinion as to the propriety of assigning the Indio specimens to *Euonymus*.

Occurrence.—One mile north of Somerville, Fayette County, Tenn.; one mile south of Grand Junction, Hardeman County, Tenn.

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MYCOLOGY.—*"Oedema," or "wart," of cultivated violet identified as scab.*[1] ANNA E. JENKINS, Bureau of Plant Industry, Soils, and Agricultural Engineering.[2,3]

This article reports the recent identification of "oedema," or "wart," of violet (*Viola odorata* L.) as the *Sphaceloma* disease now known as scab of violet (*11*). The work has involved historical research that has led to a better orientation of the almost unknown account of the "oedema," or "wart," published in 1899, as well as to a more complete documentation of what appears to be the only representative specimen. The existence of these early records was ascertained in 1932, during a preliminary study (*12*) of the scab. At that time, however, material was insufficient to permit the tracing of this fungus malady to the "oedema." As the name connotes, this was thought to be of physiologic origin. Recently, when it became a question of identifying the "oedema" as scab, ample material of the scab was available for comparison. Assembled from various places and representing the disease on wild, as well as cultivated, violet (*10*, *11*), these specimens show the range of symptoms that may be exhibited by this highly disfiguring and destructive disease.

[1] Received July 12, 1944.

[2] This paper was presented at the meeting of the Potomac Branch of the American Phytopathological Society held at the Plant Industry Station, Beltsville, Md., on February 23–24, 1944. The abstract will be published in Phytopathology.

[3] Certain historical facts reported in this article, not available from other sources, were obtained over a period of years in various personal conferences with Drs. B. T. Galloway and A. F. Woods and Messrs. W. E. Taylor, David Bissett, and J. W. Byrnes as former or present members of the U. S. Department of Agriculture. During the period with which this paper deals, Dr. Galloway was chief of the Division of Vegetable Pathology, renamed in 1895 (*4*, p. 169) the Division of Vegetable Physiology and Pathology (*16*). Dr. Woods joined Dr. Galloway's staff as physiologist in 1893 (*16*). In the same year Mr. Taylor entered the division as Dr. Galloway's clerical assistant. The two greenhouse floriculturists, Messrs. Bissett and Byrnes, in 1904 and 1906, respectively, became members of the Bureau of Plant Industry in which the "Department's work on plants was consolidated" in 1901 (*15*, p. 197) with Galloway as chief. It is a pleasure to acknowledge here the helpful assistance freely given at one time or another during the present study by all those mentioned. It is proper to mention that Dr. Woods was in attendance during the morning session, February 23, when this paper was presented.

The account of the oedema now comes to the fore not only as the first known record of violet scab, but also as one of the few *Sphaceloma* diseases encountered in the United States during the early phytopathological period. It may be stated, then, that through the effort herein recorded another advance has been made in the reconstruction of the history of plant diseases caused by *Sphaceloma*. This paper elaborates upon an aspect of early pathological history emanating from the U. S. Department of Agriculture, although barely apparent in its annals.

HISTORICAL BACKGROUND

Extraordinary interest in violets at the turn of the century is expressed in the separate section entitled "Violets" in Dr. Galloway's first annual report as chief of the Bureau of Plant Industry (*6*, p. 89, also see *14*). The pertinent passage from Galloway is quoted as follows:

> As a result of the demand for the violet and the price which it commands in the market, nearly every person interested in a general supply of cut flowers, grows or attempts to grow violets, while many others make violet culture their specialty and main dependence. In consequence of the many failures which are annually reported in this line, the work of the Experimental Gardens and Grounds has been extended to include a test of methods of culture and varieties of violets best suited to commercial growing. As a beginning in this direction two houses have been erected and so arranged that the various conditions of soil, heat, and moisture demanded by the violet can be studied. A variety collection, comprising all of the commercial sorts of both the United States and Europe, has been brought together for the purpose of determining their fitness for commercial work and their value as parent stock for new varieties.

Throughout his earlier chiefship of the phytopathological division already named, Dr. Galloway was actively concerned with diseases of violets grown under glass. This is shown by brief mention of the subject in most of his annual reports for the period, viz., 1890–1900.

Investigations of violet diseases were car-

ried out by the division not only in the laboratory and "Department greenhouse" (*cf.* 3, p. 11), but also in certain violet houses at Garrett Park, Montgomery County, Md.[4] (*cf.* 3, p. 11). These were built about 1894–95 by Dr. Galloway and P. H. Dorsett[5] and were privately owned and operated by them until about 1898; thereafter solely by Dorsett. At Dorsett's request about 1900 the violet houses were purchased by Mr. Bissett. He had received exceptional training in floriculture and had had wide experience in violet culture. In part, the original violet houses were destroyed by fire about 1904 (7, p. 237); Mr. Bissett constructed others, again in Garrett Park, and there continued with his specialty until about 1930. The blooms produced in his houses commanded the highest prices in large city markets and members of the Bureau familiar with the work still attest to their exceptional beauty, size, and fragrance. He has been, therefore, deservedly regarded as one of the most outstanding specialists in violet culture.

GALLOWAY'S TREATISE ON VIOLET CULTURE

Galloway's book on *Commercial violet culture*, published in three editions (5), commemorates his and Dorsett's experience in growing violets under glass. To quote from the preface to the first edition (5, 1899):

"I wish to express my thanks to Mr. P. H. Dorsett, who shared with me all the trials and vexations which fall to the lot of the beginners in this work. He is now a successful grower and many of the illustrations given are from his houses."

The numerous illustrations (61 halftones) in the first edition are reproductions from photographs made by Mr. Dorsett, as Messrs. Bissett, Byrnes, and Taylor affirm. This explains the source of the photograph of the "oedema," or "wart," to be mentioned later.

The book does not mention the location of the violet houses, but this is known to have been at Garrett Park, as already indicated. This is definitely mentioned by Galloway in his separate article already cited (7), in which he specifies that the varieties grown at Garrett Park were chiefly Lady Hume Campbell and to a lesser extent Marie Louise.

Chapter 8, or nearly one-fourth of the text, deals with "Diseases and Insect Enemies." This chapter embodies the investigations of the trio of scientific workers, Galloway, Dorsett, and Woods, as Dr. Woods has verified and as may be deduced from Galloway's direct reference to "Messrs. Albert F. Woods and P. H. Dorsett, who have been associated with the writer in work on plants under glass. . . ."

THE "OEDEMA"

The account of the "oedema," or "wart," with which this article is particularly concerned, is precisely the same in all three editions of Galloway's *Commercial violet culture* (5, ed. 1, pp. 182–185, fig. 55; ed. 2, pp. 186–188, fig. 57; ed. 3, pp. 193–194, fig. 59). Coon's *Practical violet culture* (2) is essentially a successor to this early treatise by Galloway and admittedly draws heavily upon it. But there is here no direct reference to the "oedema" in the much reduced discussion corresponding to Galloway's chapter 8. Gregory and Davis's (9) mention of "oedema" or "dropsy" clearly is taken from Galloway.

The section on "oedema" in Galloway's book is here quoted in full:

> Oedema, or Wart Disease. This trouble often proves quite serious, but is easily kept under control by the proper handling of the plants. The affected plants show wart-like growths over the leaves, and these are usually of a brownish color. These warty growths vary in size, some of them being quite small and others one-eighth of an inch long and one-sixteenth of an inch high. The corky growths are not confined wholly to the leaves. In fact, they frequently occur on the leaf stalks, and sometimes on the flower stalks also. It is found that where these warty formations are developed the whole leaf is in a peculiar condition. It is brittle, and when taken in the hand cracks very easily. The leaves, in other words, instead of having a live, elastic feel, appear to the touch to be dry like a shaving, and when bent will break with a cracking noise. Wherever a break of this kind occurs the corky growth appears in time. The corky formations may also develop wherever an

[4] Garrett Park is in the Rock Creek Valley, about 12 miles northwest of the District of Columbia.

[5] Mr. Dorsett was a member of Dr. Galloway's early phytopathological staff (16).

insect punctures the leaves. The punctures of aphides and the bites of spiders cause many of these swellings. When the plants get into this condition it is practically unfit for flowering, and when badly diseased it is very difficult to ever get it into proper shape again. The trouble is one that is brought on gradually by improper relations between the moisture of the soil, moisture of the air, and the light.

Where plants are mulched and the soil kept constantly wet the trouble is likely to follow, especially if heavy shading is adopted. Where the plant is grown for some time under these conditions all of its tissues get into a dropsical or oedemic state, and it needs only an injury of some kind to cause the formation of the wart-like growths. If the conditions are very favorable, injuries are not necessary for the wart-like growths, as they will be produced by the plant without intervention of anything of this kind. This is due to the fact that the plant is really making an abnormal effort at growth, and the warts are nothing more than excessive growth of the cells at particular points. This trouble seldom occurs in houses properly lighted and ventilated. In underground pits, and in outdoor frames where heavy shading is used, it is apt to occur, especially if the practice of mulching is adopted.

By paying proper attention to light, ventilation, and watering, little or no difficulty is experienced from the trouble. In case it is seen that plants are becoming oedemic it will be necessary to modify at once the surroundings to such an extent as to admit more light to the leaves and more air to the soil. It will not do, however, to bring about these changes too rapidly. Light should be gradually given, and the amount of water added to the soil should be slowly diminished. If the change is too abrupt, serious consequences may result, as the plant, having been grown under such abnormal conditions, is not able to withstand the unusual exposure to bright light and dry soil, which the sudden change might bring about.

Bearing the legend "oedema, or wart disease," an accompanying illustration, unfortunately indistinctly reproduced, represents the lower surface of a fresh, severely diseased leaf blade. Careful comparison reveals that the illustration corresponds so closely to the leaves of the specimen of the "oedema" mentioned in the introduction of the present paper (Fig. 1, *D*) that it could well represent them, i.e., when freshly gathered.

This historic specimen, undated and without a formal label, was included among the physiological specimens of the Mycological Collections of what is now the Bureau of Plant Industry, Soils, and Agricultural Engineering. It consists of several more or less broken leaves, together with numerous leaf fragments (Fig. 1, *D*, *a–d*). These leaves are definitely those of *Viola odorata*.[6] On a slip of paper within the packet is written in Dr. Galloway's hand:[7] "Soft or brown spot, Garrett Park." Penciled on the outside of the packet appears: "Called wart . . . may follow insect bites."[8] The name "oedema," which does not appear on the specimen, was original with Dr. Woods, as he has explained to the writer. In lieu of the exact date of collection, it seems reasonable to assume that it was between the years 1897–99: By 1897 a violet crop had been harvested as shown by Galloway's encouraging statement of the price received for blooms of the variety Lady Hume Campbell during the 8-month period October 1897–May 1898 (*5*, ed. 1, p. 223; ed. 2, p. 232; ed. 3, pp. 256–257); by 1899 Galloway's book was published, and, as indicated by the preface to the first edition, he was no longer connected with the violet-growing venture at Garrett Park.

Among the trio, Galloway, Dorsett, and Woods, it befell Dr. Woods as physiologist to take the lead with respect to the "oedema" as it appeared in the violet house at Garrett Park. The serious problem confronting them was to determine practical means of holding the diease in check. This Dr. Woods accomplished, and investigation into the cause of the disease was not pursued further.

Since the autumn of 1932, when violet scab first came to the attention of Massey, White, and Jenkins (*12*) through an outbreak of the disease in field plantings in Pennsylvania and New York, it has been found that the disease is more or less generally distributed throughout the District of Columbia area and not only at Garrett Park. This is shown by herbarium specimens presented in Fig. 1, *A*, which illustrates the disease on *Viola odorata* from a garden in Arlington, Va. (Fig. 1, *A*, *a*); on a wild

[6] Verification kindly made by Dr. S. F. Blake, Division of Plant Introduction and Exploration, Plant Industry Station, Beltsville, Md.

[7] Handwriting verified by Dr. Woods.

[8] Handwriting of Mrs. F. W. Patterson, who joined Dr. Galloway's staff in 1895 (*8*).

violet hybrid (*V. affinis* Le Conte×*V. papilionacea* Pursh) growing naturally in a glade in Rock Creek Park, Md. (Fig. 1, *A*, *b*), and on blue marsh violet (*V. cucullata* Ait.) from the District of Columbia (Fig. 1, *A*, *c*). Norton's (*13*, p. 117) report of an unidentified disease of violet in Maryland (place undesignated) in 1909 suggests a stil

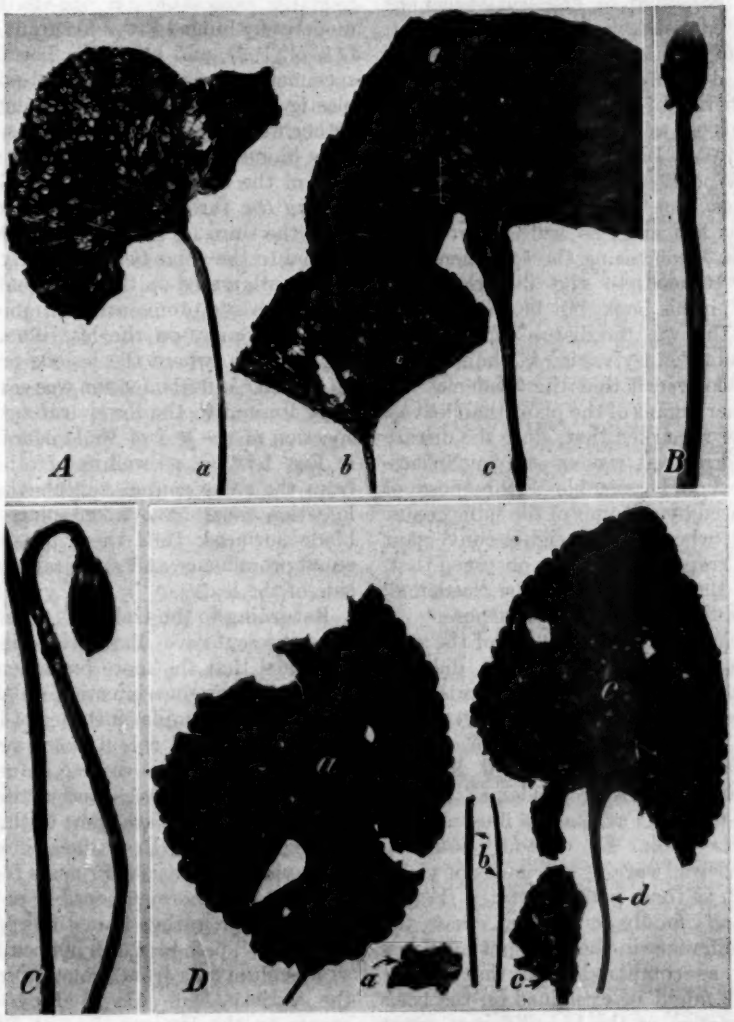

FIG. 1.—*A*, Dry pressed specimens of scab of violet representing gatherings made in the open in the District of Columbia area: *a*, sweet violet, upper leaf surface, from a garden in Arlington, Va., October 24, 1941, N. Rex Hunt; *b*, wild violet hybrid, folded parts of leaf representing lower leaf surface, Rock Creek Park, Md., October 12, 1935, J. A. Stevenson; *c*, lower leaf surface of blue marsh violet from a garden, District of Columbia, October 7, 1939, A. E. Jenkins. *B* and *C*, Fresh infected blossom stalks and capsules from same source as *A*, *c*, October 16, 1935, W. T. Swingle. *D*, "Oedema" of sweet violet: *a*, lower leaf surface; *b*, lesions on petioles; *c*, upper leaf surface; *d*, single lesion on petiole, Garrett Park, Md., 1897–1899 (see explanation in text), B. T. Galloway. All natural size. Photographs *A* and *D* by R. L. Taylor and *B* and *C* by M. L. F. Foubert.

earlier record of violet scab. Thus it reads: "Watery pimples on leaf R [symbol for 'rare'], cause (?), perhaps insect."

In the autumn of 1932, the only fresh material of scab of violet that the writer had seen consisted of diseased specimens of cultivated violet, variety Freys Fragrant, from Pennsylvania (*11*, p. 1 and pl. 1, *A–D*, and pl. 2, *A–D*, *E*, and *F*). At that time the same gathering of fresh specimens obtained for the purpose were shown to Dr. Galloway and then to Mr. Bissett, and later described to Dr. Woods. Still more recently Dr. Woods has been shown the published illustrations just cited as well as herbarium specimens. Upon seeing the specimens Dr. Galloway turned to the illustration of "oedema" in his book, but he was not certain that this was the disease affecting the violets from Pennsylvania. At the moment he could not recall that the "oedema" affected other organs of the plant than leaves. The writer remarked that, since the disease of Freys Fragrant was caused by *Sphaceloma*, it should resemble anthracnose of grape caused by a fungus of the same genus. Galloway, who was thoroughly conversant with this grape disease, then observed that, actually, the symptoms of the "oedema" resembled those of grape anthracnose.

From the writer's description of the scab on Freys Fragrant, Dr. Woods did not recognize this disease as the same as that he had known as "oedema." More recently, when he saw specimens of the disease on Freys Fragrant, he still found it different in appearance from the "oedema" he had known at Garrett Park, i.e., as illustrated in Galloway's book. Dr. Woods and the writer reviewed various specimens of violet scab, such as those here illustrated (Fig. 1, *A–C*), and finally concluded that the marked difference in the leaf spot on Freys Fragrant as compared with that of the "oedema" might be explained on the basis of the reaction of the two different sweet violet varieties to infection by the *Sphaceloma*. No physiological disturbance that might truly be called oedema was known to Dr. Woods, and none has been found by the writer in the literature on violet diseases.

On Freys Fragrant initial infection often occurs on the lower leaf surface, thus accounting for the leaf spot being generally more conspicious on that side of the leaf. Violet scab blade lesions may be surrounded by a deep green border and this is particularly noticeable on the flattened to moderately bulged Freys Fragrant leaf spot (*11*, pl. 1, *D*, and pl. 2, *F*). The Galloway specimen, shows numerous raised, hyperplastic lesions on the upper surface, together with occasional vein lesions, and two vein lesions are distinguishable near the base of the blade illustrated by Galloway. Among the three leaves illustrated in Fig. 1, *A*, the third (*c*) shows lesions practically limited to the veins below. Clearly, this infection originated on the lower leaf surface, where the symptoms are the more prominent. Similarly, on the leaf illustrated in Fig. 1, *A*, *b*, where the lesions are chiefly interveinal, initial infection was correspondingly limited to the lower leaf surface. Inspection of the leaf of *Viola odorata* shown in Fig. 1, *A*, *a*, as well as of other leaves from the same source, reveals that initial infection must have taken place on both blade surfaces: thus there are lesions of equal prominence and appearance on either side of the leaf.

Returning to the Galloway specimen and the representative illustration, it may be discerned that the more prominent lesions evidently represent infection on the upper leaf surface. A similar instance of leaf spots bulged below and raised above resulted in the case of a related disease, namely, lima bean scab, when leaves were artificially inoculated with the pathogene of that disease (*1*, Fig. 1, *A*, *B*). In artificial inoculations on leaves of the variety Princess Mary these proved to be more susceptible to infection on the lower, rather than the upper blade surface (*11*, p. 8, pl. 4, *A*). The culture used as inoculum was from violets, probably of the variety Mrs. David Lloyd George, grown on the Hudson, i.e., at Rhinebeck, N. Y.

Among all those who saw the fresh severely diseased specimens of Freys Fragrant in 1932, Mr. Bissett was the only one to whom the disease was familiar. With his broad knowledge of violets he at once named the particular variety and as quickly

recognized the malady. Essentially, his statement was as follows:

"The disease is what has been called 'oedema.' Stems and blossom stalks, as well as leaves, may be affected. When the trouble is present, cultural conditions are unfavorable. Cold, too much moisture, and poor ventilation are environmental conditions favorable to the disease. I have received specimens from various places; once I took a specimen to Dr. E. F. Smith, who told me that the disease was caused by a fungus."

More recently, Mr. Bissett has stated that when Galloway and Dorsett were contending with the "oedema" at Garrett Park, violet growers on the Hudson also were having to deal with it. He offered the further information that when he acquired the violet houses at Garrett Park he removed the partitions, thus improving air circulation, and exercised particular care to keep the plants dry, and in this way completely eliminated the disease. Mr. Bissett stated also that he had observed the "oedema" on wild violets in a woodland near Garrett Park.

In critical examinations of *Sphaceloma violae* Jenkins, as the pathogen of violet scab is designated (*11*, p. 7), the writer has found it more satisfactory to examine petiole rather than blade lesions for hyphal fragments, stromata, and also conidia. Following this plan in the examination of the Galloway specimen, microscopic preparations were made from scrapings from the delicate petiole lesions (Fig. 1, *D*, *b* and *d*). A few hyphal fragments, together with a number of conidia recognizable as of the *Sphaceloma*, were found in these mounts.

A summary of the known distribution of violet scab (*10*) shows that the disease now has been found in this country in all coastal states from Massachusetts to Texas, except Delaware[9]; outside the United States its known geographic range includes New South Wales in Australia, and the Union of South Africa, in Africa.

[9] The presence of violet scab in Louisiana was ascertained when Dr. M. A. Petty, formerly of the Southwestern Louisiana Institute, Lafayette, La., remarked upon seeing illustrations that he was familiar with this same disease as affecting wild violet on the horticultural farm of the Institute. Specimens had been collected a number of times during class excursions, he said, but remained unidentified.

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MYCOLOGY.—*The fungus genus* Cheiromyces, *with description of a new species.*[1]

G. W. MARTIN, State University of Iowa.

Some pieces of oak bark collected in Iowa City and placed dry in a sterile Petri dish on August 17, 1943, were moistened on November 20. Late in December numerous small black sporodochia were observed to have developed, which appeared to belong to a species of *Cheiromyces*. Attempts to determine the species led to a realization of the uncertainty that exists concerning this genus.

Cheiromyces has a curious history. It was first mentioned quite casually in a footnote on page 312 of Berkeley's *Cryptogamic botany* (1857). On the following page crude drawings are reproduced of *C. stellatus* B. & C. from specimens on *Scirpus eriophorus* sent from Pennsylvania by Michener. No formal description is given, but it is clear that the fungus bore its spores on a sporodochium, that the hyphae were dark, and that the spores were composed of two to four parallel digits arising from a common base. No septa are shown in the spores, but it is difficult to conceive of such spores without septa. Eighteen years later (Grevillea **3**: 97. 1875) a brief diagnosis of the genus and species (the specific name misspelled *stillatus*) was published, with citation of the earlier mention in the *Cryptogamic botany*. In addition to the collection from Pennsylvania, another one from Alabama, by Beaumont, is recorded, apparently on the same substratum, with the added comment "On a *Sphaeropsis*," which presumably applies to both.

The Alabama collection may be the source of the material distributed by Curtis as *C. beaumontii* B. & C. The latter name was apparently never validly published, and doubt has been expressed as to whether it is conspecific or even congeneric with the material to which the name *C. stellatus* was first applied. Saccardo, however (Sylloge **4**: 554. 1886), cites it as a synonym.

Peck (Bot. Gaz. **5**: 35. 1880) described a second species, *C. tinctus*, from Vermont. He states that in external appearance it closely resembles "*C. beaumontii* B. & C., of which Dr. Curtis distributed specimens but of which I have seen no description. In it the spores are smaller, of a brown color and destitute of septa." The spores of *C. tinctus* are described as having 2 to 5 divisions, these 1–3-septate and tinged with blue, 12.5–18μ in length. In compiling this and the preceding species Saccardo lists the genus under the Dematiaceae but notes: "Ad Tubercularieas nutat."

Two additional species were added to the genus. *C. comatus* Ell. & Everh. (Proc. Acad. Nat. Sci. Philadelphia **1893**: 171) was described from *Azalea* twigs in New Jersey and *C. speiroides* Höhn. (Ann. Myc. **1**: 408. 1903), from coniferous wood in lower Austria. Also, Ellis distributed material as *C. beaumontii* B. & C. on *Acer* and *Pyrus* in N. A. Fungi 762, with the note: "Sec. to specc. in herb. Curtis."

Höhnel's description is very full and precise. The spores of his fungus are septate, commonly 6-celled, and attached at one of the central cells, after which the two ends bend upward so that they are more or less parallel. He discusses the previous species and transfers *C. comatus* to *Exosporium*. Later (Sitzb. Akad. Wiss. Wien, math.-nat. Kl., Abt. I, **119**: 664. 1910), he reviewed the entire genus. He states that the fungus is no longer present on the type material of *C. stellatus* at Kew but decides, on the basis of Berkeley's figure, that the spores are unseptate. He is convinced that *C. beaumontii* B. & C. is not a synonym of *stellatus*, as had been supposed, but is not only specifically but generically distinct. He therefore erects for it the genus *Cheiroconium*, which he assigns to the Melanconiaceae and states that he does not doubt that *C. tinctus* Peck is the same species. His own *C. speiroides* he removes from *Cheiromyces* on the basis of the multicellular spores and the pale or hyaline hyphae of the stromatic base, erecting for it the new genus *Cheiromycella*, suggesting that *Speira inops* Bomm. Rouss. & Sacc. may also be included. This reduces *Cheiromyces* to Berkeley's original and somewhat uncertain species as reported in 1857.

Examination of the material distributed by Ellis as *C. beaumontii* in N. A. Fungi 762

[1] Received July 6, 1944.

suggests that if this is really the same as the specimen from Alabama originally sent to Berkeley by Beaumont, Höhnel is correct in removing it from *Cheiromyces*. It is at least equally probable, however, that the Ellis collections represent an entirely different fungus. On the basis of Peck's description, it may be doubted whether *C. tinctus* is the same, particularly as Peck implies that he had seen *C. beaumontii* as distributed by Curtis.

Dr. G. R. Bisby has been kind enough to examine the material of *C. stellatus* in the Kew Herbarium and found a brown septate body that may represent a spore or part of a spore of the *Cheiromyces*, although he adds "no trust can be placed in it." He found several spores of *C. "beaumontii,"* the second collection later assigned by Berkeley to *C. stellatus*. These are brown, digitate, and septate, although Berkeley's drawings on the cover depict it as without septa and correspond in all essential respects with the drawings made from Michener's Pennsylvania collection. We are therefore justified in assuming that the spores of the original collection were also brown and septate.

FIG. 1.—*Cheiromyces digitatus* n. sp. Photomicrograph of section through acervulus, ×300.

There still remains to be considered the question as to whether *Cheiromyces* is distinct from *Speira* and *Dictyosporium*. Lindau (in Rabenh. Krypt.—Fl. **9**: 163. 1910) places both the latter genera in his subsection Coniothecieae, lacking differentiated conidiophores. Berlese's illustration of *Speira toruloides* Corda, reproduced on page 198, shows spores strongly suggesting those of the Iowa fungus although somewhat larger. The distinction between the two genera is that in *Dictyosporium* the

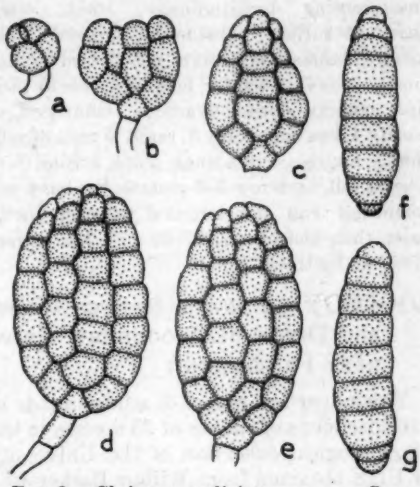


FIG. 2.—*Cheiromyces digitatus*, n. sp. Spores: *a–c*, Successive stages in development; *d*, *e*, mature spores, as seen in face view; *f*, *g*, same, seen from side. All ×1,000.

conidial chains remain together, while in *Speira* they tend to separate. Guéguen (Bull. Soc. Myc. France **21**: 98. 1905) denies that this is a valid generic distinction. Incidentally, Lindau cites *Botryosporium* Schw. 1832 as a synonym of *Speira* Corda 1837. If the two are synonyms, then Schweinitz's name is valid, but only reference to the latter's specimen can decide that point. In the present instance, however, the constant occurrence of a definite sporodochium in the *Cheiromyces* and the complete lack of any suggestion of separation of the filaments making up the compound spore seem to warrant recognizing Berkeley's genus and assigning it to the section Dictyosporae of the Tuberculariaceae, among the dark-spored genera. Since the Iowa collection seems clearly distinct from Berkeley's species, it is described as new.

Cheiromyces digitatus, n. sp.

Epixylo, superficiali; sporodochiis pulvinatis, atris, minutissimis, 0.2–0.3 mm latis, ex hyphis hyalinis dense compositis, strato conidiorum tectis; conidiis nigro-olivaceis, multicellularibus, planis, e cellulis adnatis, in ordinibus 3–4(–5) longitudinalibus instructis, 27–39×15–22×6–10μ.

Sporodochia pulvinate, circular or elliptical in outline, 0.2–0.3 mm in diameter, sometimes

anastomosing longitudinally, black, often hoary at surface; substance composed of obscurely filamentous, septate, gelatinized hyphae mostly 3–4μ in diameter, bearing spores at their tips; conidia dark olivaceous, composed of mostly 4, less commonly 3, rarely 5 rows of cells closely appressed in a single plane, arising from a basal cell, each row 3–7-septate, the basal cell somewhat and the terminal cells distinctly paler than the others, 27–39 × 15–22μ in face view, 6–10μ thick.

On oak bark in moist chamber, Iowa City, Iowa, December, 1943. *G. W. Martin* 4921, type.

As may be seen from the illustration, especially Fig. 2, *a–c*, the development of the spores of *C. digitatus* is fundamentally different from the process as described by Höhnel for *C. speiroides*. It seems probable, therefore, that his removal of the latter species to his new genus *Cheiromycella* is justified, although for a reason different from that originally stated.

ZOOLOGY.—*Notes on Mexican snakes from Oaxaca.*[1] By ANGUS M. WOODBURY and DIXON M. WOODBURY, University of Utah. (Communicated by HERBERT FRIEDMANN.)

This paper is a report of studies made of 136 specimens of snakes of 25 species in the herpetological collection of the University of Utah obtained from Wilbur Barker who reports that they were collected from the general vicinity of Tehuantepec, Oaxaca, Mexico, on the Isthmus of Tehuantepec. According to notes of field collections, most of them come from places in or near the city, but a few specimens are reported from areas 10 or 15 miles away. These notes have also been useful in helping to elucidate the habitats occupied.

We are greatly indebted to Dr. Hobart M. Smith for advice during the progress of the study and for his comments and criticism of our views of the problems. All colors are referred to the *Dictionary of color* by Maerz and Paul.

Leptotyphlops phenops phenops (Cope)

Six specimens, usually found under litter. They show unusually high total scale counts. The rostral is white dorsally and is completely separated from the supraoculars by the nasals. The scales usually have dark brown centers, which become lighter ventrally and in some cases become indistinguishable from the edges. The scale edges are light brown, sometimes giving a whitish aspect. Dorsally the dark centers tend to connect in longitudinal series to form seven dark stripes which usually have a beaded appearance due to the narrow connections between the dark centers. The tail beyond the end of the stripes is black above and is white below for half or two-thirds of its length, the white involving the tip.

Scalation of 5 specimens: Total scales from rostral to tip of tail 251, 256, 261, 265, 277; subcaudals 19, 18, 19, 17, 17; longitudinal scale rows 14.

Measurements: Total length 76, 155, 81, 195, 171 mm; tail length 5, 8, 5, 10, 8 mm.; ratio of tail to total length 6.6, 5.2, 6.2, 5.1, 4.7 per cent.

Loxocemus bicolor bicolor Cope

LIGHT-CHINNED AMERICAN PYTHON

Five specimens (UU 2507 ♂, 2522 ♂, 2707 ♂, 2718 ♀, 2800 ♂) from wooded areas containing fallen logs, leaf litter, and loose soil, where it is usually concealed in the litter, under logs, or behind the bark. According to the collector's notes, the two forms of *Loxocemus* are found in the same habitat.

The dorsal color is a dark brown, darkest on the head; the ventral is light gray with slight variations. Details of color and scalation will be discussed under *L. b. sumichrasti*.

Loxocemus bicolor sumichrasti Bocourt

DARK-CHINNED AMERICAN PYTHON

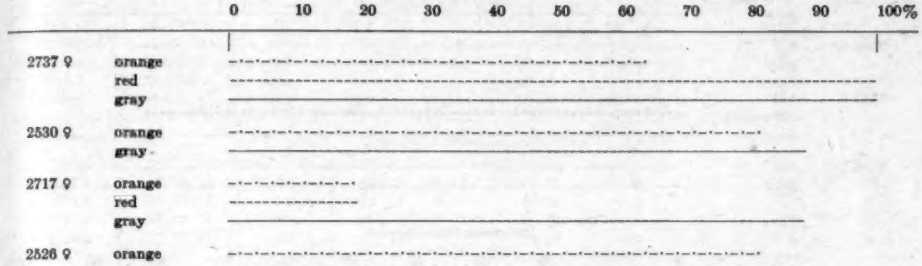
Four specimens (UU 2526 ♀, 2530 ♀, 2717 ♀, 2737 ♀) from the same habitat where *L. b. bicolor* was found. The dorsal color is essentially alike in the two forms, but differences occur on the ventral surface. These colors are analyzed quantitatively as well as qualitatively in the following table, which is based upon the *Dictionary of color*, by Maerz and Paul, 1930. This shows for the dorsal, ventral, and chin colors for each specimen the Maerz and Paul number in the dictionary and the components of the inks used to produce those colors as sorted out

[1] Received April 24, 1944.

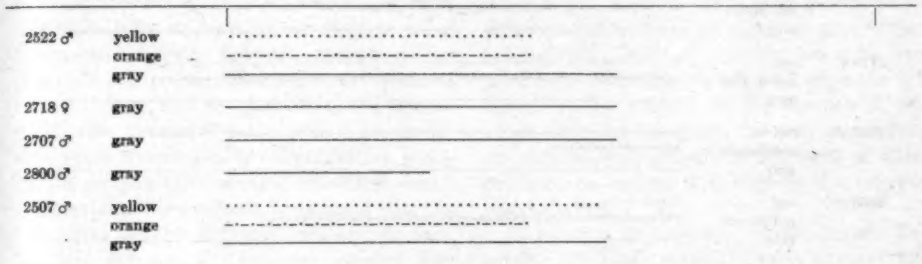
and translated into percentage in the various columns. These percentages are based upon the gradations used in the dictionary to produce the various hues and thus represent quantitative measurements of the colors of the snakes in terms of the colors found in the dictionary.

ABDOMINAL COLOR

Loxocemus bicolor sumichrasti

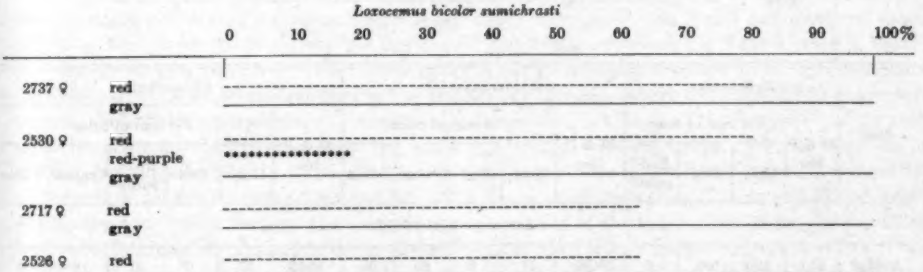


Loxocemus bicolor bicolor

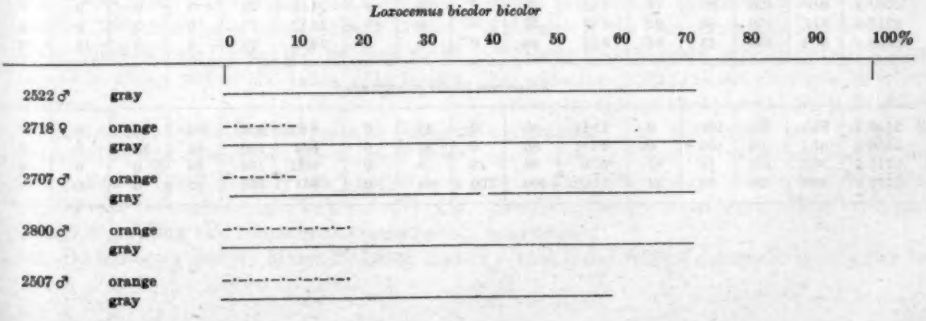


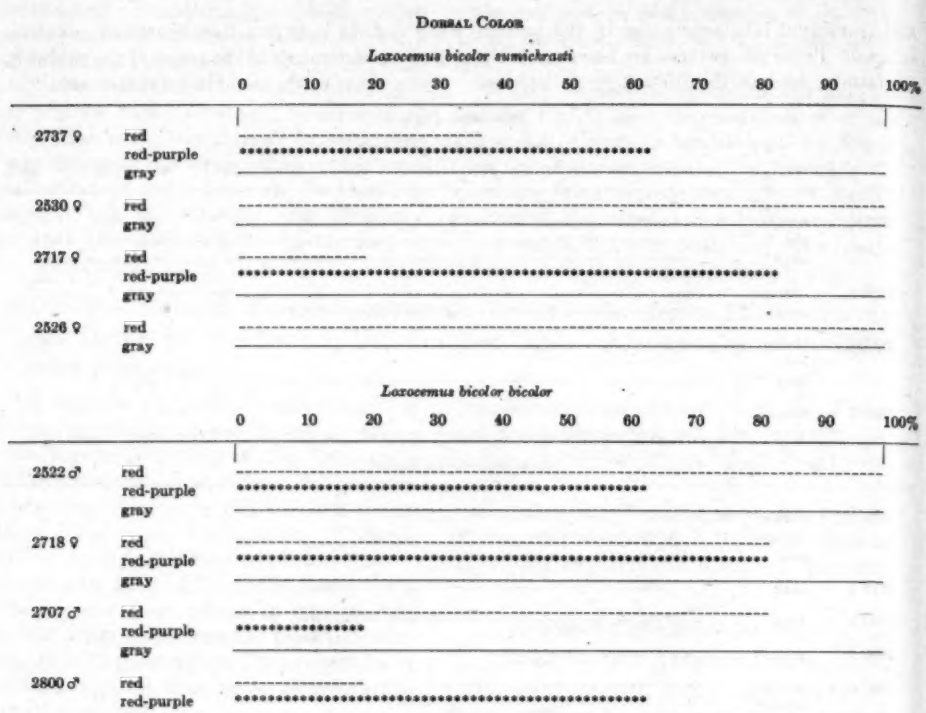
CHIN COLOR

Loxocemus bicolor sumichrasti



Loxocemus bicolor bicolor





Nos.	Dorsal color				Abdominal color					Chin color					
	M & P No.	Per cent of color			M & P No.	Per cent of color				M & P No.	Per cent of color				
		Gray	Red	Red-purple		Gray	Red	Orange	Yellow		Gray	Red	Red-purple	Orange	Yellow
Loxocemus bicolor bicolor															
2507 ♂	8L1	100	100	0	13G6	57	0	45	55	13A3	57	0	0	18	0
2522 ♂	8H4	100	64	64	13F6	57	0	45	45	14A1	71	0	0	0	0
2707 ♂	8J2	100	82	18	5A7	57	0	0	0	14A2	71	0	0	9	0
2718 ♀	8J5	100	82	82	5A7	57	0	0	0	14A2	71	0	0	9	0
2800 ♂	8C4	100	18	64	3A7	28	0	0	0	14A3	71	0	0	18	0
Loxocemus bicolor sumichrasti															
2526 ♀	8L1	100	100	0	7A11	86	0	82	0	8H1	100	64	0	0	0
2530 ♀	8L1	100	100	0	7A11	86	0	82	0	8J2	100	82	18	0	0
2717 ♀	8C5	100	18	82	7C9	86	18	18	0	8H1	100	64	0	0	0
2737 ♀	8E4	100	36	64	8L10	100	100	64	0	8J1	100	82	0	0	0

The following table gives comparative material on scalation and measurements:

Number	Scale Rows	Abdominals	Caudals	Labials		Length			Ratio %
				Supra	Infra	Body	Tail	Total	
Loxocemus bicolor bicolor									
2507 ♂	31–33–25	254	42	11–11	12–12	477	56	533	10.5
2522 ♂	31–33–26	256	39	11–11	12–12	652	68	720	9.4
2707 ♂	31–35–26	260	41	11–12	12–12	620	67	687	9.8
2718 ♀	29–33–25	254	42	11–11	12–13	695	80	775	10.3
2800 ♂	33–33–25	256	40	11–11	14–13	878	86	964	8.9
Loxocemus bicolor sumichrasti									
2737 ♀	31–33–25	263	46	11–11	14–13	1061	125	1186	10.5
2530 ♀	31–33–26	252	42	9–9	11–12	555	60	615	9.8
2717 ♀	31–33–26	254	41	11–11	11–12	647	72	719	10.0
2526 ♀	31–33–25	251	41	10–10	12–13	543	62	605	10.2

Discussion.—Dr. Hobart M. Smith (1943, p. 445) has considered these two forms as distinct species, but the evidence at our disposal raises the question whether they are separate species or merely subspecies. Admittedly, the evidence is inconclusive, and any decision at the present time, based upon such evidence as is now available, must of necessity be only tentative, pending the accumulation of more conclusive data.

No evidence is available to indicate that the two forms occupy different habitats. In fact, the field notes of the collector indicate that both forms were taken from the same habitat in wooded areas containing leaf litter, fallen logs, and loose soil, presumably during the dry season. Smith (letter, March 5, 1944) adds that they appear to be underground during the dry season. Without contradictory evidence, it must be assumed that they occupy the same niche in the same habitat in Oaxaca.

According to Smith (letter, September 19, 1942), the two forms occupy the same range from the Isthmus of Tehuantepec northwestward to Morelos and Guerrero, a distance of about 300 miles; but beyond that to Colima, another 300 miles, only *sumichrasti* is known, while southeastward from the isthmus to El Salvador, about 400 or 500 miles, only *bicolor* is known.

Presumably, the habitat occupied in Oaxaca is typical of that throughout the range of both forms. Smith (1942, p. 201) has implied in a similar case that there might be some sort of a barrier separating two forms in the same habitat. He indicates (letter, March 5, 1944) that such barriers may include breeding at different times of year, repugnance to odor, emergence at different times of day or night, or many other possibilities. To date, however, no such barriers have been discovered; at least none are known to the writers. In the absence of evidence about such barriers, one way or another, the writers are inclined, on the basis of other evidence, to assume that they do not prevent interbreeding.

In relation to scalation, Smith (letter, December 23, 1943) states, "I early dropped the idea of any constant differences in scutellation; they may exist, but I did not discover them, and those proposed by Taylor do not hold." Smith's conclusion seems to fit our specimens from Oaxaca, where the chin-shield characters suggested by Taylor (1940a, p. 447) show considerable intergradation. We do not know whether there might be constant differences between specimens from Colima and El Salvador, extremes of the two ranges. If so, the condition in Oaxaca would indicate intergradation. Otherwise, the hereditary scutellation in the two forms is so nearly identical as to be indistinguishable in the present state of knowledge.

Dorsal color appears to be as indistinguishable as scalation. It is in the ventral color where differences appear. Some are darker than others underneath. The abdominal color seems to show some indications of intergradation between the dark and light phases, but chins show decided contrast, some light, others with dark markings.

This is the critical difference in heredity be-

tween the two forms, and the question arises whether such differences could be maintained in heredity if interbreeding occurs. So far as the writers are aware, there is nothing in genetics against the idea of inheritance of alternative characters in the same interbreeding population. The light and dark chins may well be alternative characters transmitted by the same parents. They may even be unit characters that cannot intergrade.

Klauber (1936, p. 18; 1939, pp. 1–23) has shown that king snakes in California may transmit to different members of the same brood either the striped or the banded pattern, which would be suspected of belonging to much more complicated heredity patterns than the chin color of the American pythons. It thus seems that it stands well within the realm of possibility, as well as of probability, that these chin patterns could well be transmitted within an interbreeding population in distinct form so that the possessors could readily be distinguished from one another, even though they might intergrade or be indistinguishable in all other characters.

If it be an interbreeding population where the two ranges overlap, how can the spread of one form to the north and the other to the south be explained? Would it necessarily imply that the two forms had once been separated and had later been freed of the separating barrier and are now gradually mixing so that the forms will eventually become completely mixed and the distinctions vanish? Or might it imply that the two types arose in the same population and one spread southward and the other spread northward? If so, might this be another example of the principle of segregation of different types in different geographic areas of which there are so many examples everywhere, the genetics of which are discussed by T. Dobzhansky in his *Genetics and the origin of species* (1937, p. 147), and by R. C. Murphy in his article on "The Need of Insular Exploration as Illustrated by Birds" (Science **88**: 535). 1938)?

In light of the well-known Jordan's rule, which holds that the nearest relative of a species is not found in the same area, but in an adjacent area separated by some sort of barrier, it could not be maintained that these forms represent different species unless a barrier of some sort could be found to prevent interbreeding and force them into different niches in the habitat.

The rule of ecological incompatibility, based upon extensive evidence from paleontology, zoogeography, and taxonomy, is even more convincing. This rule (Ángel Cabrera, 1932, p. 114; 1935, p. 509) holds that "related animal forms are ecologically incompatible, and their incompatibility is the more profound, the more directly they are related." It seems inconceivable that two forms could occupy the same ecological niche in competition with each other without either interbreeding or being crowded into separate niches.

In light of the available evidence, it seems that the weight tips the scales heavily in the direction of the idea that the snakes represent one species with two subspecies that interbreed in the intermediate range. This conclusion seems tenable unless and until evidence is found to show that the two forms occupy different niches in the same habitat separated by some kind of barrier. This conclusion seems to be in harmony with the practices in the much more intensively studied fields of ornithology and mammalogy.

Constrictor constrictor imperator (Daudin)

BANANA BOA

Three females, found around banana groves. Dorsal ground color light brown or gray. Dark lines on head form a cross between eyes. A series of 25 to 29 dark brown biconcave transverse dorsal blotches, sometimes with small light centers and sometimes connected laterally to enclose oval dorsal areas of lighter ground color. A dorsolateral series of small triangular blotches are separated anteriorly by a lighter line about 2 or 3 scales wide from the dorsal blotches with which they tend to alternate, but with which they tend to coalesce posteriorly, enclosing portions of the light line which finally disappear before the tail is reached. A series of diamond-shaped dark brown light-centered lateral blotches run the length of the body. Ventral ground color is creamy white, mottled with light brown and with a tendency toward a double row of black spots or groups of spots which run the length of the body and fuse into a single row on the tail.

Dorsal scale rows, 54-63-36, 60-75-41, 55-75-36; supralabials, 16-16, 19-20, 18-18; infrala-

bials, 19-19, 23-23, 22-23; dorsal body blotches, 27, 25, 29; abdominals, 240, 250, 257; caudals, 59, 68, 67 respectively; anal entire. Greatest length, body 646 mm, tail 83, total 729; tail 11.4 to 13.1 per cent of total length.

Masticophis mentovarius mentovarius
(Duméril and Bibron)

Six specimens, all collected in banana groves, apparently feeding on rats and mice. These specimens of different sizes and ages show sequences in changes of the color pattern. The most conspicuous juvenile pattern occurs on a specimen (UU 2771 ♀) 1,130 mm in length and probably about three years of age. The top of the head is dark brown, and this extends onto the sides but is there mottled with cream, especially on the preoculars and postoculars and upper labials. Behind the head the brown dorsal color is darker in the neck region but lighter on the posterior half of the body, where it becomes suffused with pink, especially on the sides and on the tail. The ventral ground color is cream or yellow anteriorly and is mottled on chin and throat with dark brown spots which tend to form two central rows. The cream or yellow ground color is gradually replaced by pink on the posterior abdomen and tail.

On the side of the neck a series of distinct light and dark lines extending backward tend to become fainter and disappear posteriorly, but two of the lines persist faintly as far as the anus. Each dark line consists of dark spots or streaks through the center of successive scales with one exception, in which case the line is located on the ends of abdominals. The light lines include the lateral edges of the scales and tend to run between the scale rows. Dorsally the dark spots on the scales become enlarged and occupy most of the scale surface and the light lines tend to become obsolete. One centimeter behind the head the first, second, and fifth light lines are most conspicuous. Four centimeters behind the head the fourth line is lost by reduction of scale rows. Posteriorly the lines disappear by reduction in contrast of colors.

A second specimen (UU 2784 ♂) of approximately the same size and age, 1,160 mm in length, has the same pattern except that the lines do not persist so far posteriorly.

An 866-mm specimen (UU 2715 ♀) about two years of age shows essentially the same pattern with slight variations. Just behind the head the second and fifth light lines are most conspicuous, and dorsally the ninth light lines form a conspicuous pair that extend backward a short distance and forward to make semicircular turns around the side of the neck to the angle of the mouth just missing the last upper labials. The dorsal color anteriorly behind the head is dark gray rather than brown.

A 548-mm specimen (UU 2719 ♀) about one year of age closely resembles the preceding specimen except that the first light line is nearly as conspicuous as the second and the ninth stripes although discernible are inconspicuous.

By contrast with these young specimens, two older specimens (UU 2528 ♂, 2792 ♀), 1,690 and 1,741 mm in length, except for a decided reduction in the line effects, show the typical color pattern with brown head, dark gray dorsal anterior color intergrading posteriorly with brown and ventral color essentially as previously described. Some of the lateral lines are faintly discernible, the second being most conspicuous.

Scalation: Scale rows, 19-17-13; supralabials, 7-7; infralabials, 10-10 in four specimens, 9-10 in one, and 9-9 in one. Preoculars 2-2 in five, and 3-2 in one specimen; postoculars, 2-2; loreals, 1-1 in four specimens, 1-2 in one, and 2-2 in one. Nasal divided.

Slight sexual dimorphism is indicated in the following comparison of the sexes: 2 males show 187 and 192 (189.5) abdominals, 109 and 114 (111.5) subcaudals, 836 and 1,225 mm body length, 324 and 465 mm tail length, and ratios of 27.5 and 27.9 per cent tail to total length; whereas 4 females show comparative figures of 194 to 201 (198) abdominals, 107 to 112 (109) subcaudals, 410 to 1,292 mm body length, 138 to 449 tail length and ratios of 25.2 to 27.3 per cent tail to total length.

Discussion.—Basically the striping pattern of longitudinal dark spots or streaks through the centers of scales and light streaks between scale rows formed by light lateral edges is identical with the striping pattern of *M. t. taeniatus*. Even the emphasis on the stripes is very similar. The light stripes are more conspicuous on the sides, but the dark stripes so dominate the dorsum that the light stripes are nearly obsolete in both races.

There are, of course, some differences. In *taeniatus* this pattern is distinctly visible

throughout the full length of the body and extends even on to the tail, whereas in the young of *mentovarius*, up to about three years of age, it is distinctly visible only on the anterior part of the body and fades posteriorly until it is nearly obsolete near the anus. In adult specimens, however, this fading is much more pronounced but is generally recognizable on the neck, even though it may become completely obsolete elsewhere.

This similarity of the adult *taeniatus* to the young *mentovarius*, even though the posterior part of the pattern is only faintly visible, is so striking as to strengthen the hint given by Hartweg and Oliver (1940, p. 19) that *mentovarius* might belong to the *taeniatus* group. This raises the question of whether the faintly visible pattern of the young *mentovarius* is an expanding pattern which will eventually spread to the adult stage or a remnant of a more complete pattern like that of *taeniatus* which has been nearly lost in the adult and is now being suppressed in the young.

The preponderance of available evidence favors the latter idea that color patterns of young reptiles are atavistic. It is consonant with the general idea of growth and development in which the zygote is generalized and successive steps of cell multiplication offer chances for more and more specialization. The older the individual and, consequently, the farther removed from the zygote the greater is the chance for divergence from ancestral conditions. This idea is essentially in agreement with Eimer,[2] who outlined color pattern changes in the lizards of the genus *Lacerta* of the Old World and with Cope,[3] who did likewise with the lizards of the genus *Cnemidophorus* in the New World both of which practically parallel the present case. In both genera striping was considered to be primitive, and it was shown that adults of some species maintained the striped pattern throughout life, whereas others abandoned the striped color pattern of the young in later stages of life, and developed other color patterns of broken lines, crossbands, reticulations and finally spots on a plain background, some species reaching one stage, other species continuing on through to the other stages.

In the absence of evidence to indicate a mutation producing a striped pattern of the embryo from nonstriped parents in the *Masticophis* snakes, the alternative idea of atavistic color patterns in the young becomes predominant.

In the matter of scalation, Stuart (1941, p. 31) indicates a reduction trend in dorsal scale rows in the *Dryadophis–Salvadora–Masticophis-Coluber* series. If this conclusion be accepted, then the higher scale formula, 19-17-13 in *mentovarius* is doubtless more "primitive" than the 15-13 formula of *taeniatus*. This suggests the idea that the latter has been obtained by reduction from a larger scale-formula, probably similar to that of the former.

If the implications of Stuart (*ibid.*) in relation to the probable derivatives of *Dryadophis* are tenable, then it seems possible that the genus *Masticophis* could have been derived from South American stock that spread northward through Central America. In that case, the evidence would tend to support Smith's hypothesis (1941, pp. 388, 396) that the northern races had been derived from primitive stock south of the Isthmus of Tehuantepec.

The evidence from scalation is in agreement with this hypothesis, but the evidence from color pattern seems to call for a slight modification of Smith's (*ibid.*) conclusion that *mentovarius* "represents the nearest approach to the ancestral type of pattern in the genus." This can be brought into harmony by assuming that the primitive ancestor had both high scale-formula and full body pattern. Then both *taeniatus* and *mentovarius* could be derived, the former by reduction in scale formula, the latter by reduction of color pattern from the primitive conditions.

Thamnophis ruthveni Hartweg and Oliver

Eight specimens were collected in light brush open fields, and pastures, around water. These snakes fit closely the description of Oliver (1938, pp. 1–4) from this same locality. The lower two postoculars are white as is the posterior half of the preoculars. Two males have: Abdominals 151, subcaudals 71 and 74, body length 346 and 350 mm, tail length 96 and 102 mm, ratio of tail to total length 21.7 and 22.6 per cent. Six females have: Abdominals 143 to 152 (146), subcaudals 59 to 70 (63.7), body length 334 to 570 mm, tail length 94 to 130 + mm, ratio of tail to total length 20.4 to 22.0 per cent.

[2] Archiv für Naturg. **1881**: 239.
[3] *The primary factors of organic evolution:* 41–45. 1896.

Salvadora lemniscata (Cope)

Nine specimens were collected in banana and coconut groves and open fields. These specimens all agree with Bogert's description of this species (1939, pp. 140–147). Eight males have: Abdominals 200 to 206 (203), subcaudals 135 to 140 (138), body length 721 to 1,150 mm, tail length 344 to 485 mm, ratio of tail to total length 30.9 to 32.3. One female has: Abdominals 205, subcaudals 141, body length 752 mm, tail length 348 mm, ratio of tail to total length 31.6 per cent.

Drymobius margaritiferus fistulosus Smith

Two specimens, an adult female and an immature male. In general, the adult fits Smith's description (1942, p. 383) of the types. The black scales with light centers show considerable variation, but all or nearly all show a complete black border. On the dorsum the light center is light blue, with a longitudinal yellow streak through its center. On the sides the blue center gradually increases its area on each scale at the expense of the black until the first scale row and the ends of the ventrals show the light blue areas in conspicuous contrast with the narrow black borders which are wider on the posterior edges. In the same direction the yellow streak diminishes in intensity until it is nearly obsolete on the first scale row and entirely missing on the ends of the ventrals. The black borders of the ventrals (abdominals and subcaudals) are limited to the extreme ends.

The young male is similar, except that the yellow streak is missing in the blue portions of the scales and the ventrals have longer and more conspicuous black borders.

Scalation: Scale rows 17-17-15. Supralabials 8-8 with 4 and 5 in orbit and 3 barely entering, and 9-9 with 5 and 6 in orbit and 4 barely entering. Infralabials 10-10 and 10-9. Preoculars 1-1; postoculars 2-2. Abdominals 148 and 151; subcaudals 29 + and 117.

Length: Body 645 and 199; tail 105 + and 104 mm; total 750 + and 303. In young male, tail represents 34.3 per cent of total length.

Dryadophis melanolomus tehuanae Smith

Six specimens collected in hilly country in second-growth timber. In alcohol, general appearance above, nearly unicolor (lighter on tail) slate tinged with blue or brown and slate blue in freshly shed specimens. Closer examination, however, reveals that many scales have dark edges anteriorly and slate blue centers, whereas other scales, especially on the anterior part of the body, have the dark pigment extending over most of the scale. All scales have white fringes on the posterior V-shaped edges which produce the appearance of diamond shaped white markings around each scale, which is a conspicuous feature of the general pattern.

Scalation: Dorsal scale rows 17-17-15. Supralabials 9-9 except one which is 8-9. Infralabials 10-10 in 3 specimens, 9-10 in two and 9-9 in one. Preoculars 1-1 in 4 specimens and 2-2 in two. Postoculars 2-2. Abdominals 177, 178, 181, 181, 183, 184. Caudals in the same sequence 55 +, 107, 113, 97 +, 103, 111. Body lengths 591 ♂, 675 ♂, 709 ♂, 740 ♀, 765 ♂, 780 ♀ mm; tail lengths 222 +, 165 +, 283, 306, 326, 314 mm; total length in same sequence 813 +, 840 +, 992, 1046, 1091, 1094 mm. Ratio of tail to total length, males 28.5 to 29.9 per cent; females 28.7 to 29.3 per cent.

Drymarchon corais melanurus (Duméril and Bibron)

Three specimens, two females and a male, which seem to be intergrades between *melanurus* and *rubidus* as described by Smith (1941, p. 476). Two of the snakes, Nos. 2583 ♂ and 2746 ♀, are nearer *melanurus* than *rubidus*. They are both distinctly lighter anteriorly than posteriorly. The preocular labials are partly edged with black, and the light areas of the labials are light brown, not white. Most of the posterolateral gular scales are tipped with black. Anteriorly, about one-third of the ventral plates are black on the posterolateral surface of one or both sides. Although not of regular pattern, these black streaks become progressively longer and more frequent until they cover the scales forming a solid black color posteriorly on body and tail for about one-third of its length. No. 2521 ♀ is nearer *rubidus*, being much darker dorsally than the others, but there is much less contrast between the anterior and posterior portions of the body. The dorsal surface of the head is nearly black. All the supralabials are edged posteriorly with black, and the light areas are light brown. Nearly all of the gular scales are tipped with black. The ventral pattern, although similar to the others, has much more black pigment.

Scalation: Supralabials 8-8; infralabials 9-9. Dorsal scale row formula 19-17-15 or 14. Abdominals: one male 188, 2 females, 195 and 191. Subcaudals: male 78, females 72 and 71. Measurements. Body length: male 1,320 mm, females 1,215 and 840 mm. Tail length: male 321, females 281 and 201 mm. Ratio of tail to total length: male 19.6 per cent, females 18.8 and 19.3 per cent.

Elaphe chlorosoma (Günther)

A young female showing distinctly the juvenile pattern has a series of 59 dorsal blotches with light brown centers and dark brown edges on the body and 25 less distinct blotches on the tail. These body blotches, reaching to the fourteenth scale rows, run transversely diagonal across the dorsal surface through the light brown ground color. Anteriorly on the body there is a series of lateral blotches which alternate with the dorsal blotches for about one-fourth the length of the body. Posteriorly they become indistinct. The ventral surface is immaculate.

Scalation: Scale rows 31-37-23. Abdominals 274; subcaudals 111. Anal divided. Supralabials 8-8; infralabials 9-10. Preoculars 1-1; postoculars 2-2. Length of body 585 mm; of tail 149 mm; total 734 mm. Tail represents 20.3 per cent of total length.

Leptophis diplotropis diplotropis (Günther)

Fourteen specimens, arboreal in habit, from banana groves and light forested areas. The basic color is blue, darker above than below. In alcohol, it varies dorsally from a light blue (34 F 6 near lotus) through varying stages of pigmentation to a very dark blue (40 A 6 near slate). Two phases of coloration seem to be exhibited, a dark and a light phase.

The light phase has a black line running through the orbit, extending forward faintly to nostril and involving the upper edge of labials. Posteriorly, it occupies the lower postocular, most of the first temporal, the lower post temporal, upper edges of last two labials and the lower edge of the upper posttemporal. The head above is light blue and below is mainly white, usually being suffused with blue on the upper labials and the lateral gulars.

Behind the head the black line widens until it involves scale rows 3 to 6 and edge of row 7. Back about 5 or 6 centimeters this line begins to break into obliquely transverse dark blotches, which gradually become less distinct and disappear about a third or half way along the body. Along the center of the back, the vertebral scales are much lighter in color, some nearly white, giving the appearance of a chain of light-colored diamonds. Behind the neck the paravertebral scales become keeled and the keels become colored black, thus forming a pair of narrow black paravertebral lines which extend backward to the anus. The white of the throat gradually becomes suffused with blue posteriorly.

The dark phase is similar but darker and has black covering the entire top of the head and neck, except the light vertebral diamonds.

Scalation: Scale rows 15-15-11. Supralabials 8-8, except one 8-9; infralabials, 10 with 11-11, 3 with 11-10, and 1 with 10-10. Preoculars 1-1; postoculars 2-2. Loreal single. Nasal divided.

LEPTOPHIS DIPLOTROPIS DIPLOTROPIS (GÜNTHER)

No.	Sex	Abdominals	Caudals	Length			Ratio (%)
				Body	Tail	Total	
2567	♂	169	117+	601	—	—	—
2569	♂	173	152	610	334	944	35.4
2579	♂	171	137	642	346	988	35.0
2713	♂	171	127	636	339	975	34.8
2714	♂	174	138	691	345	1036	33.3
2728	♂	172+1	137	682	355	1037	34.2
2729	♂	173	148	768	441	1209	36.5
2730	♂	174	111+	682	306+	988+	—
2753	♂	173	134+	710	379+	1089+	—
2791	♂	176	134	763	393	1156	34.0
2754	♀	177	99+	750	302+	1052+	—
2765	♀	175	116+	632	291+	923+	—
2766	♀	172	125	630	312	942	33.1
2772	♀	174	134	595	311	906	34.3

Trimorphodon biscutatus biscutatus
(Duméril and Bibron)

Fourteen specimens, nocturnal in habits, from hillsides and lowlands, light forests, or open areas.

Coloration: Gray above, yellowish below with dark brownish-gray blotches forming series along the back, along the sides and along the ends of the ventrals. The dorsal series shows a great deal of variation, ranging from plain transverse light-centered blotches (secondary), toward one extreme becoming narrower and less distinct until only a light brown area is left (tertiary blotches), and toward the other extreme becoming wider and more conspicuous

until some partially split to make pairs of light centered blotches (primary) joined at the lateral ends; but occasionally separated.

According to our interpretation these variations of blotches represent developments of some at the expense of others. In order to explain the present pattern, we propose to assume a hypothetical primitive ancestral pattern derived from evidences still persisting on the specimens. This pattern consisted of light areas alternating with dark dorsal blotches which numbered about 65 to 72 on the body and a similar pattern extended on to the tail.

A change in this pattern was produced by expansion of alternate dark blotches, correlated with a suppression of the others both in size and color, leaving a pattern of about 32 to 36 dark blotches alternating with light tertiary blotches bordered by the primitive light interblotch areas, presumably like *quadruplex*.

Some specimens show an additional or secondary reduction, especially in the midbody region, in which some alternate dark blotches (usually not all) expand in correlation with suppression of those secondary dark blotches between them, leaving a pattern usually unchanged on neck and posterior body, but showing in midbody some expanded primary blotches alternating with narrower more or less suppressed secondary blotches which in turn are bordered by the plain remnants of the tertiary blotches which again are usually bordered by the light interblotch sections. In a few cases, these latter light areas are missing and the plain tertiary remnants are fused with the secondary blotches to make one on the dorsum but laterally the three are often clearly indicated.

The number of primary blotches left depends largely upon the number and amount of secondary reductions. It is nearly impossible to set a precise limit between primary, secondary and tertiary blotches because they show all degrees of gradation between them. Separated on the basis of judgment, the specimens show a range of 20 to 33 primary blotches.

Scalation: In all specimens, both nasal and anal are divided; both pre- and postoculars are 3-3, except one specimen which has 4 postoculars on one side. Some variable characters are listed in the table below.

A comparison of ventrals on our specimens with similar data taken from Smith (1941, p. 158; 1943, p. 492) for populations from nearby regions is given as follows: UU specimens: Abdominals 245 to 267 (259), subcaudals 83 to 96 (88), total ventrals 335 to 357 (346). *T. b. semirutus:* abdominals 260 to 275, subcaudals 85 to 102, total ventrals 358 to 376. *T. b. biscutatus:* abdominals 251 to 271, subcaudals 81 to 96, total ventrals 343 to 359. *T. b. quadruplex:* abdominals 251 to 263, subcaudals 82 to 93, total ventrals 334 to 347.

Imantodes splendidus oliveri Smith

Two females from open forested areas and hillsides. Color patterns fit description given by Smith (1942, p. 388).

Scalation: Dorsal scale rows 17-17-15. Anal divided. Supralabials 8-8. Infralabials 10-10.

THAMNOPHIDON

No.	Sex	Scale rows	Abdominals	Caudals	Total ventrals	Labials		Loreals	Body blotches	Length			Ratio (%)
						Supra	Infra			Body	Tail	Total	
2523	♂	25-25-20	255	96	351	9-9	13-13	3-3	21	771	184	955	19.3
2722	♂	26-27-20	254	93	347	10-9	12-13	4-3	27	860	202	1062	19.0
2744	♂	25-25-20	245	90	335	9-9	12-12	3-3	20	452	96	548	17.5
2554	♀	25-26-19	262	85	347	9-9	13-12	2-2	22	941	184	1125	16.4
2710	♀	25-26-19	264	86	350	9-9	13-13	3-3	23	490	99	589	16.8
2711	♀	25-27-19	266	83	349	9-9	12-12	2-3	22	951	183	1134	16.1
2721	♀	25-25-20	247	91	338	9-9	12-12	2-3	22	767	189	956	19.8
2745	♀	25-27-20	261	83	344	9-9	12-13	2-3	22	467	88	555	15.9
2760	♀	27-28-20	267	64+21	352?	9-9	12-13	3-3	24	1074	177+	1251+	—
2762	♀	26-26-19	253	84	337	9-8	12-13	3-3	24	724	171	895	19.1
2770	♀	25-26-21	267	90	357	9-9	13-14	3-3	24	994	135+	1129+	—
2776	♀	23-26-19	262	86	348	9-9	12-12	3-3	23	559	105	664	15.8
2777	♀	25-27-20	264	88	352	9-9	14-14	3-3	22	881	189	1070	17.7
2783	♀	25-28-22	256+1	69+17	342?	9-9	13-13	3-3	33	930	160+	1090+	—

? indicates estimated value.

Preoculars 1-1, postoculars 2-2. Loreal single. Nasal single. Abdominals 237 and 225; caudals 132 and 123, respectively.

Length: Body 628, tail 252, total 880 mm; body 605, tail 239, total 844 mm. Tail 28.6 and 28.3 per cent respectively of total length. Vertebral scales only slightly larger than adjacent paravertebral scales.

Leptodeira maculata (Hallowell)

Three specimens found usually in brush. Dorsal ground color light brown. There are 26–29 dark brown blotches extending from the neck to the anus and 12 on the tail. Some of these blotches are confluent. The blotches extend laterally to the first, second, or third scale rows. Ventrals immaculate.

Scalation: Nasals divided. Loreal single. Both preoculars and postoculars 2-2. Supralabials 8-8; infralabials 10-10. Anal divided. Scale rows 21-21-17, 21-23-17, 21-25-17. Abdominals 167, 171, 175. Subcaudals 74, 33 +31 estimated (broken), 67.

Body lengths 380, 408, 494 mm, tail lengths 115, 56 +, 121 mm. Ratio tail to total length: male 23.2 per cent, female 19.7 per cent. Body blotches: male 26, female 29. Tail blotches 12.

Manolepis putnami (Jan)

Three specimens collected toward evening on open roads around open brush under which they spend the night, according to the collector. The color fits the description given by Cope (1898, p. 1092).

Scalation: Dorsal scale rows 19-19-15. Anal divided. Upper labials 8-8. Lower labials 10-10. Preoculars 1-1. Postoculars 2-2. Loreal absent. Nasal divided. Abdominals: one male 169, 2 females 179 and 180. Subcaudals: male 73, females 64 and 65.

Body length: male 399 mm, females 315 and 500 mm. Tail length: male 121, females 77 and 130 mm. Ratio of tail to total length: male 23.3 per cent, females 19.6 and 20.6 per cent.

Conophis vittatus viduus Cope

Sixteen specimens taken from sparsely wooded or lightly forested areas, particularly around the edges of openings in the forests. Ground color creamy white with one dorsal and two lateral black or brown stripes, two or three scale rows wide, beginning at the rostral edge and running posteriorly to the tail where they become faint on the tip. The lateral stripes border the upper edge of labials and pass through the orbit under the supraoculars.

Scalation: Dorsal scale rows 19-19-17 in all but two specimens which show 19-19-15. Anal divided. Upper labials 7-7. Lower labials 8-8 in 4 specimens, 9-8 in one, 9-9 in eight, 9-10 in two and 10-10 in one. Preoculars 1-1 in twelve specimens, 1-2 in three and 2-2 in one. Postoculars 2-2. Loreal single. Nasal divided. Abdominals: 9 males 154 to 166 (159.6), 7 females 162 to 170 (167). Subcaudals: males 61 to 69 (65), females 57 to 67 (62.8).

Total length: males 454 to 724 mm, females 222 to 752 mm. Tail length: males 111 to 156 mm, females 45 to 142 mm. Ratio of tail to total length: males 20.8 to 24.9 per cent, females 17.4 to 20.8 per cent.

Oxybelis acuminatus (Wied)

Nine specimens taken in arboreal habitats in low second-growth timber. Ground color generally ashen to brownish gray and brownish red, both below and above. Head above same as body. Supralabials creamy white separated from dorsal head color by a black line which extends from edge of rostral along upper border of labials to neck region. Lower labials, chin and neck are creamy white, the color gradually fading into ground color on first few abdominals.

Scalation: Dorsal scale rows 17-17-13 in all but two specimens which show 17-17-15. Anal divided. Upper labials 9-9 in 6 specimens, and 9-10 in three. Lower labials 9-9 in 2 specimens, 10-10 in two, 10-11 in three, 10-12 in one, and 11-11 in one. Preoculars 1-1. Postoculars 1-1 in two specimens, and 2-2 in seven. Loreal absent. Nasal single. Abdominals: 5 males 186 to 194 (191), 4 females 188 to 199 (193.5). Subcaudals: 5 males 167 to 181 (175), 3 females 163 to 168 (165).

Total length: 5 males 1,276 to 1,468 mm, 3 females 1,313 to 1,395 mm. Tail length: 5 males 531 to 609 mm, 3 females 510 to 539 mm. Ratio of tail to total length: 5 males 40.4 to 42.1 per cent, 3 females 38.6 to 38.8 per cent.

Tantilla rubra Cope

Two specimens, female and juvenile, found under refuse and fallen timber, feeding prin-

cipally on small insect life, according to the collector. Color as described by Smith (1942, p. 40), except that in addition part of the lower labials are black.

Scalation: Scale rows 15-15-15. Abdominals 147 and 164; subcaudals 60 and 68. Labials all 7-7 except one with infralabials 6-6. Preoculars 1-1; postoculars 2-2. Loreal missing; nasal divided; anal divided.

Length: 260+85 mm and 116+31 mm; totals 345 and 147 mm; ratio of tail to total, 24.6 and 21.1 per cent.

Coniophanes imperialis copei
Hartweg and Oliver

Three specimens collected under refuse and fallen timber. Color as described by Hartweg and Oliver (1938, p. 4). In addition, the male is darker than the females and all three specimens show two short lines produced by rows of dark specks on the ends of the anterior ventrals.

Scalation: Dorsal scale rows 19-19-17. Upper labials 8-8. Lower labials 9-9. Preoculars 1-1. Postoculars 2-2. Loreal single. Nasal divided. The male has 128 abdominals, 78 subcaudals, body length 234 mm, tail length 110 mm, total 344 mm, tail 31.9 per cent of total length. Two females have 131 and 135 abdominals, tails broken, body lengths 172 and 220 mm.

Coniophanes piceivittis Cope

A single specimen, a female, was collected. Dorsal ground color dark brown, with two dorsolateral white stripes running from the rostral above the orbit along the edge of the supraocular, along the outer edge of the parietals and on to the neck 6 or 7 scales, where they are broken for 2 scales and thence extend posteriorly to the tip of the tail. The white stripes occupy scale row 8 and halves of 7 and 9. The ventrals and the first three scale rows are immaculate, except on chin, lower and upper labials where the white is conspicuously stippled with dark brown. The yellow parietals and frontal are also stippled with brown.

Scalation: Dorsal scale rows 23-25-19. Anal divided. Supralabials 8-8; infralabials 10-10. Preoculars 2-2; postoculars 2-2; loreal single; nasal divided. Abdominals 172. Part of the tail is missing. Body length 155 mm.

Micrurus ephippifer (Cope)

A single female was collected under rubbish. Tip of head back to posterior tip of frontal, tip of parietals on top and postoculars and half of third supralabial on sides is black; mental and first two infralabials are also black. Behind this black ring is a yellow ring (white in alcohol) which extends back nearly to the posterior edge of the parietals and laterally through the last infra and supralabials. Behind this is a black nuchal color which involves the posterior tip of the parietals and extends posteriorly eight scales in the dorsal surface and ends on the fourth abdominal ventrally. There are fifteen black rings (5 abdominals wide) on the body and three on the tail. These 15 complete black rings are bordered on both sides by yellow (white) rings about 2½ scales wide which enclose 14 red rings that have the dorsal surfaces mostly replaced by black but some red edges persist. This dorsal black extends down the sides usually to the third, second or first scale rows producing some concave borders anteriorly and a few black spots occur on the ventral surface.

Scalation. Scale rows 15-15-15. Labials 7 and 7. Preoculars 1-1; postoculars 2-2. Loreal absent. Nasal divided. Abdominals 224; subcaudals 36. Body length 400 mm, tail 41 mm, total 441 mm. Tail 9.3 per cent of total length.

Stenorhina freminvillii lactea Cope

Two females collected in underbrush. Color in alcohol light red above on head, body, and tail. This color becomes gradually lighter on sides and fades into pink on the ventral surface, being darker under the tail and progressively lighter anteriorly toward the chin. The upper and lower labials are a very light pink. One specimen has a narrow black streak beginning on the upper edge of second supralabial which extends backward along the upper edge of the labials, through the eye, involving the preocular, lower postocular and ending on the seventh labial. On the other specimen, this line is nearly missing. Both specimens show suffusion of dark pigment on the parietals and indications of a faint middorsal line extending backwards.

Scalation: Dorsal scale rows 17-17-17. Anal divided. Labials all 7-7 except one has 7-8 infralabials. Preoculars 1-1; postoculars 2-2. Loreal 1-1 in one specimen, and 1-0 in the other. Nasal divided; temporals 1-2-3. Abdominals 167, 179;

caudals 39, 35. Body length 472, 510 mm; tail length 83, 73 mm; total length 555, 583 mm. Tail 15 and 12.5 per cent of total length.

Bothrops dunni (Hartweg and O'iver)

Eleven specimens, four adults, and seven juveniles from wooded and brushy areas around open fields, in nearly the same type habitat as the rattlesnake. Color as described by Hartweg and Oliver (1938, p. 6). The dorsal blotches vary from 13 to 20 in number. Adult males are darker than the females and some of the juveniles can be similarly separated, but others are indistinguishable.

Scalation: Dorsal scale rows 23-23-19 in six specimens and 25-23-19 in three specimens. Anal entire. Supralabials 9-10 in two specimens, 10-10 in five, 10-11 in one, and 11-11 in one. Infralabials 9-11 in one specimen, 10-10 in four, 10-11 in three, and 11-11 in one. Preoculars 3-3. Postoculars 3-3 in seven; 3-4 in one, and 2-2 in one specimen. Nasal divided. Abdominals: 7 males 145 to 151 (147), 4 females 150 to 156 (152.5). Subcaudals: males 37 to 41 (40), females 32 to 38 (35). Body length: Males 159 to 348 mm, females 192 to 415 mm. Tail length: males 23 to 56 mm, females 22 to 53 mm. Ratio of tail to total length: males 12.1 to 13.9 per cent, females 10.3 to 11.6 per cent.

Crotalus atrox Baird and Girard

A single female was collected. Dorsal scale rows 25-25-21. Anal entire. Supralabials 16-15; infralabials 16-16. Preoculars 3-3; postoculars 2-3. Loreal single. Abdominals 179; subcaudals 24. Length: body 294 mm, tail 20 mm, total 314 mm. Tail 6.4 per cent of total length. Body blotches 39; tail blotches 6. The snake contained a *Cnemidophorus* lizard.

Crotalus durissus durissus Linnaeus

A single female was collected. Dorsal scale rows 29-31-21. Anal entire. Supralabials 16-15; infralabials 15–17. Preoculars 1-1; postoculars 2–3. Loreals 2–2. Abdominals 184. Subcaudals 26. Dorsal body blotches 27. Length: body 408 mm, tail 32 mm, total 440 mm. Tail 7.3 per cent of total length.

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ZOOLOGY.—*A new brittle-star* (Ophiocoma anaglyptica) *from Canton Island.*[1]

CHARLES A. ELY, University of Wisconsin. (Communicated by AUSTIN H. CLARK.)

H. L. Clark lists 19 species for the genus *Ophiocoma* Agassiz in his "The Echinoderm Fauna of Torres Strait."[2] All these have been known for 25 years or, in many cases, much longer. Since the publication of Dr. Clark's paper, apparently only three new species have been assigned to the genus, and one has been removed to the new genus *Ophiocomella* established by A. H. Clark in 1938. In view of the fact that the genus is a conspicuous one and already well known, the addition of another species is rather remarkable, although perhaps not surprising since the fauna of many isolated Pacific islands is still incompletely known.

Ophiocoma anaglyptica, n. sp.

Named *anaglyptica* (embossed) in reference to raised interbrachial plates.

Description.—The disk is about 20 mm in diameter, with well-spaced granules that encroach upon the interbrachial areas to a variable extent. Among the normal scales thus exposed in each interbrachial area are a number of enlarged bare plates, usually between 25 and 30. The genital slits are bordered by eight to ten small granules. In length the arms are about five times the width of the disk. The upper arm plates, which are thickened and raised above the general surface, are about two and one-half times as broad as long; of irregular outline and extremely variable in shape. The majority of these plates suggest an open low-arched fan from which one of the lateral angles has been sheared abruptly. The uppermost arm spine on the side of the missing angle is greatly swollen and enlarged, while a similar spine on the opposite side of the same segment is lacking. As a rule there is an alternation of this arrangement from segment to segment. Thus an upper plate with the right angle missing and a

[1] Received July 15, 1944.
[2] Carnegie Inst. Washington Publ. 214 (Dept. Mar. Biol., vol. 10). 1921.

swollen dorsal spine will be followed by one with a deficient left angle and a swollen left dorsal spine. Occasionally both upper plate angles are present, in which case the large spine is lacking on both sides. Conversely, both angles may be lacking and both upper spines present and enlarged. The first few segments frequently bear five spines; the next few four; and the remainder bear three on one side and four on the other alternately down the arm.

The lowermost spine is the shortest and tends to taper to a flattened blunt tip. The second lowest is slightly longer and spatulate. The next spine above is about a third longer than the one below and tapers to a rounded tip. The highest spine, when present, is typically bottle-shaped, expanded in the middle but slightly compressed; as a rule, narrowing abruptly to form a short neck. It is about two and one-half to three segments long.

There are two tentacle scales on all but the first two or three segments, each of which may bear three.

The shape of the oral shields is typical of the genus. They are roughly obovate with the proximal border nearly straight. The triangular adoral shields are equilateral and separated by the width of the oral shields. There are generally eight distinct oral papillae, with two or three small granular ones at the apex which are indistinguishable from dental papillae. The first is rectangular and lies above the second which is round and scalelike; the remainder are toothlike. There are five or six dental papillae.

The lateral arm plates are barely visible above and below.

The under arm plates are as broad as long, regular in size and shape, and overlap distally. They are pentagonal, with gently rounded angles and with slightly concave sides.

The color of dry specimens is uniformly chocolate-brown above except for white bands extending the length of the lower three arm spines and, in some instances, spotted areas at the base of the uppermost spines. The lateral intersegmental spaces are occasionally white with conspicuous black stripes extending between the lateral arm plates.

The oral surface is variously spotted and mottled with white, yellow, and light brown. The teeth and oral papillae are almost entirely white. The oral shields and proximal ventral arm plates are mottled with white and brown, but farther out on the arms the ventral plates are colored with barely visible dense dark spots on a slightly lighter background. The two lowermost spines are nearly all white near the disk; farther out they are white at the tip and become dark brown near the base. In some cases they are spotted similarly to the lower arm plates.

As seen from within the radial shields are small for the genus.

Locality.—Canton Island, reef; near shore beneath loose coral blocks. Three specimens were collected November 18, 1941.

Remarks.—The presence of 25 to 30 enlarged interbrachial plates serves to separate this new species from *O. scolopendrina* and *O. erinaceus*,

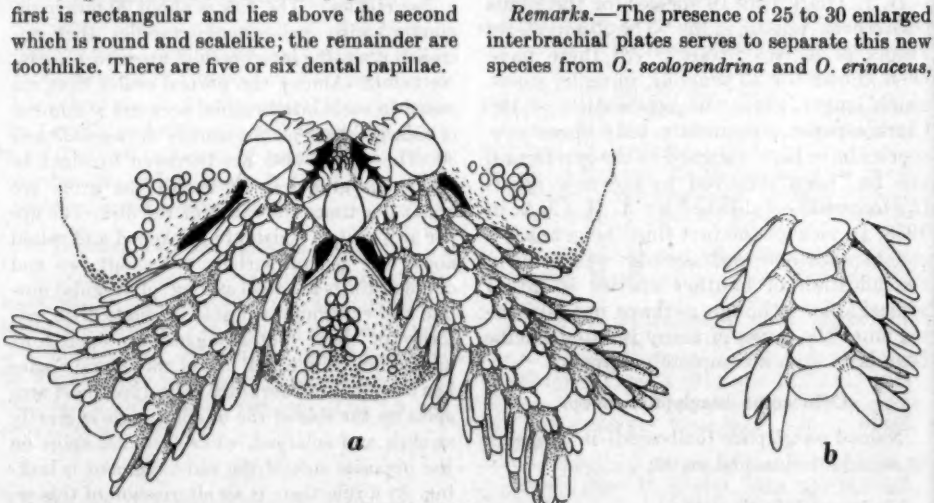

FIG. 1.—*Ophiocoma anaglyptica*, n. sp.: *a*, Oral view of disk and arm bases; *b*, aboral view of arm.

with which it seems most closely allied. Both of these species may show the general arrangement of arm spines and dorsal arm plates, but with less extreme and less regular development. In these species the fan-shaped or triangular dorsal arm plates are sheared to a lesser degree at the lateral angles, and consequently the uppermost arm spines of each segment are less conspicuously developed. However, three and four spines on opposite sides of the same segment occur in some specimens of these species. Often both species possess the flattened spatulate lower spine. In general, as shown by comparison of specimens from Canton Island, *anaglyptica* approaches *scolopendrina* more closely than *erinaceus* in these respects. However, considerable individual variation very likely occurs.

In coloration, *anaglyptica* is somewhat intermediate. The uniform coloration suggests *erinaceus*, but it is not black. On the other hand, the lighter spotted and mottled oral surface and striped lateral intersegmental areas are more typical of *scolopendrina*. Further noteworthy differences may be seen in the disk granules which are more widely and evenly spaced in *anaglyptica* than in either *erinaceus* or *scolopendrina*. Also the shape of the second innermost oral papilla is distinctive for *anaglyptica*. In this species it is round and scalelike, whereas in *erinaceus* and *scolopendrina* it is rectangular.

ICHTHYOLOGY.—*A description of a new gobiid fish from Venezuela, with notes on the genus* Garmannia.[1]

ISAAC GINSBURG, U. S. Fish and Wildlife Service. (Communicated by LEONARD P. Schultz.)

The specimens forming the basis of this paper were collected by Dr. Leonard P. Schultz, curator of fishes in the U. S. National Museum, on his recent expedition to Venezuela and turned over to me for study. These comprise one specimen of *Evorthodus lyricus*, 45 specimens of *Bathygobius soporator*, and 158 specimens, in six samples, belonging to populations of *Garmannia*, most nearly related to *G. spes*. The latter specimens illustrate a common course of speciation in fishes.

Garmannia spes was described by me (JOURN. WASHINGTON ACAD. SCI. **29**: 62. 1939) from three small specimens, not in very good condition, which were brought back from the Canal Zone by Dr. Samuel F. Hildebrand in 1937. The samples collected by Dr. Schultz in Venezuela are evidently closely related to *spes*. Although these samples were taken in comparatively close proximity, within a range of about 50 miles, yet they show average morphological differences, but of varying degrees. The populations represented by the samples examined are divisible into two primary groups, which may be treated as representing two species. The other differences, within the primary groups, are of lesser degree, racial, or subspecific at the most. One of the species from Venezuela is evidently the same as the Panamanian *spes*. The other species is here described as follows and named for Dr. Leonard P. Schultz:

[1] Received July 25, 1944.

Garmannia schultzi, n. sp.

Diagnosis.—Anterior part of body naked, scaled posteriorly. Transverse row of scales on caudal base absent. A lengthwise row of 3–6 nonimbricate, spaced scales behind pectoral base. Head depressed to subterete. First dorsal spine not prolonged. Dorsal rays usually 11, often 12. Anal rays usually 10, often 9, infrequently 8. Pectoral rays modally 17, often 18, sometimes 16, infrequently 19. Usually diffusely and irregularly cross-banded, alternating lighter and darker, irregular areas; often nearly uniformly colored, especially in the larger males; caudal uniformly pigmented or faintly cross-banded, band at base usually rather more prominent; ventral aspect usually more or less pigmented, moderately or not much lighter than side. Extent of squamation differing markedly with sex, less extensive in male, as follows (also differs with population, see below). Male: scales extending forward to a point under base of fifth to tenth dorsal ray; transverse rows of scales 7–12, longitudinal rows 3–5. End of maxillary reaching approximately to under posterior margin of eye. Female: scales extending forward to under base of third to eighth ray; transverse rows 9–14; longitudinal rows 3–7. Maxillary ending under posterior margin of pupil.

Holotype.—U.S.N.M. no. 121546, male, 22 mm, Lago de Maracaibo, 7 km south of Maracaibo City; gravel and sand; March 6, 1942; Leonard P. Schultz.

Paratypes.—U.S.N.M. no. 121547; 19 males, 12–21 mm, 14 females, 12–17 mm; obtained with the holotype.

Other specimens examined.—Lago Maracaibo at Yacht Club, just north of Maracaibo City, hard bottom, rubble to gravel; 4 males, 17–28 mm, 2 females, 21–23 mm, 1 specimen, 13 mm, sex not determinable by external examination; these 7 specimens in two samples, collected March 5 and May 16, U.S.N.M. nos. 121549 and 121550, respectively. Salina Rica, coast of El Tablazo (the latter a bay between Lake Maracaibo and Gulf of Venezuela, partly continuous with both), 5 km north of Maracaibo City; bottom thick vegetation in mud; 5 males, 21–28 mm, 2 females, 24 mm, all in one sample collected February 20, U.S.N.M. no. 121548. Ciénaga del Guanavana, on coast of Gulf of Venezuela, 12 km north of Sinamaica; swampy bottom; March 11, one male, 29 mm, with 16 pectoral rays, 2 specimens, partly dried, with 17 rays, U.S.N.M. no. 121552. All specimens collected by Dr. L. P. Schultz in 1942, in brackish water. (Dr. Schultz kindly furnished the ecological notes. A discussion of the itinerary during which the samples were taken is given by Dr. Schultz in a paper entitled "The Catfishes of Venezuela, with Descriptions of Thirty-eight New Forms," Proc. U. S. Nat. Mus. **94**: 173–338. 1944.)

Squamation.—The extent of squamation, both vertically and horizontally, varies widely with the individual, and the norm differs with the population. There are several ways in which the variability of this character may be expressed: (1) by counting the number of transverse rows; (2) stating the position of the anteriormost scales with reference to the second dorsal base; (3) counting the number of longitudinal rows; (4) noting whether the dorsal aspect of the caudal peduncle is scaled over or naked. The first two ways express the horizontal extent of squamation; the last two the vertical extent. All the four ways have been determined on the specimens examined.

In counting the transverse rows, the first row usually consists of one or two scales; this row was included in the count. The number of transverse rows constitutes a fair numerical expression of the horizontal extent of squamation. It is more difficult to express adequately the variability in the vertical extent, as the number of longitudinal rows is much fewer and, what is more important, there is much greater variability in the number of individual scales in the different rows. The number of scales in the two outer longitudinal rows, one above and below, is very variable, often consisting of only one scale, and such a row was also included in the count. Therefore, it is evident that the number of longitudinal rows represents only a very roughly approximate expression of the vertical extent of squamation.

The spaced scales in the row behind the pectoral base are often partly or wholly missing in preserved specimens, being more or less deciduous. However, when missing, the edge of the scale pocket may be readily raised with a dissecting needle, and the number of scales originally present in any given specimen may be thus ascertained. The distribution given in Tables 2 and 3 includes specimens so determined.

Sex differences.—Males and females differ in the extent of squamation, and it is necessary to separate data for scale characters by sex, as is done in Tables 2 and 3. This is a sex difference that is out of the ordinary in fishes. Table 1 also shows some average sex differences in fin-ray counts; but these differences are slight and their reality may be doubted. They may be due to vicissitudes of sampling.

Comparison.—Garmannia schultzi is very closely related to *G. spes*. The most divergent character separating them is the pectoral count. They overlap even in this character (Table 1) but the degree of divergence is high. Their index of divergence, using the measure proposed by me (Zoologica **13**: 253–279. 1938), is 92, which is of the magnitude of full species. The population represented by the holotype also differs to some extent from *spes* in the extent of squamation, but the Salina Rica population of *schultzi* nearly agrees with *spes* in this respect.

As there is no other widely divergent character to correlate with the pectoral count, single specimens usually can not be distinguished with certainty. If a specimen has 15 pectoral rays it almost certainly belongs to *spes*, and if it has 18 or 19 rays, it evidently belongs to *schultzi;* but

single specimens having 16 or 17 rays (these are the counts in which the majority of the specimens fall, 16 and 17 being the modal counts of *spes* and *schultzi*, respectively) can not be identified with assurance, and it is necessary to have a sample of 5 or 10 specimens for a satisfactory identification. For instance, in a sample of three specimens from the Ciénaga del Guanavana (see above), one had 16 and the other two 17 pectoral rays, and it is consequently most likely that this small sample belongs to a population of *schultzi*.

Populations.—Though it is true that they are relatively near one another geographically, the populations of *schultzi* represented by the samples examined apparently differ to a considerable extent morphologically. The differences in the extent of squamation, as expressed by the number of transverse and longitudinal rows and the number of spaced scales in the row behind the pectoral base, are shown in Tables 2 and 3. The small samples examined suggest that the population living 7 km below Maracaibo City diverges from the Salina Rica population, which is only 5 km above Maracaibo City, to a degree that may prove to be of subspecific magnitude when adequately larger samples are examined. Another difference between these two populations, which is also a result of the difference in the extent of squamation, is as follows: In the Salina Rica population the dorsal aspect of the caudal peduncle is partly or almost wholly scaled over, while in the population about 12 km farther south it is naked. The Salina Rica population also may possibly prove to average slightly fewer dorsal and anal rays (see Table 1), but such differences, if real, are evidently of very low degree.

The southernmost population of *schultzi* examined averages the least extent of squamation, consisting in some extreme variants, usually males, of virtually nothing more than a moderate elongate patch on the caudal peduncle. The population at the Yacht Club is, in general, morphologically about intermediate between the two populations compared above; but only one specimen out of seven has the dorsal aspect of the caudal peduncle scaled, being in this respect nearest the southernmost population.

The sample taken in a bayou near Sinamaica, which is referred to below to *spes*, is possibly just another closely related local population which, however, has diverged from the others to such a degree that it may be treated as a distinct species. This Venezuelan population is morphologically near enough to the Canal Zone population, originally described as *spes*, for the two to be treated taxonomically as belonging to one species. If this conjecture (that the Venezuelan sample of *spes* represents merely a highly divergent local population) is tenable, it follows that among these populations morphology is not always regularly correlated with geographic distribution. The population at the Yacht Club is geographically as well as morphologically intermediate between the populations north and south of it; but the population near Sinamaica, which is here referred to *spes*, is sandwiched in between populations that are sufficiently divergent from it to be properly placed in another species.

It should be added that the samples examined are not strictly comparable for size; the 34 specimens of *schultzi* from south of Maracaibo City are considerably smaller than most specimens in the other samples of the same species. However, the full adult squamation appears to be developed in specimens as small as 14 mm, and the differences outlined above are evidently population differences.

The ecological factors are not well enough known for one to discuss adequately, or speculate about, influence of environment on morphological diversification. The nature of the bottom does not seem to be decisive, as *schultzi* seems to inhabit both soft and hard bottoms (see above). All the populations referred to *schultzi* were taken in saline water, while the Venezuelan sample of *spes* was taken in fresh or nearly fresh water. However, the original sample of *spes* from the Canal Zone was taken in saline water also; consequently, salinity likewise does not seem to play a decisive role.

Garmannia spes Ginsburg

Garmannia spes Ginsburg, Journ. Washington Acad. Sci. 29: 62. 1939.

Sample collected in a caño [bayou] about ½ km west of Sinamaica (the latter about 55 km north of Maracaibo City), Gulf of Venezuela; in thick vegetation on mud; nearly fresh water; L. P. Schultz; March 11, 1942; 52 males, 18–41 mm, 55 females, 15–27 mm, U.S.N.M. no. 121551.

As shown in Tables 1–3, the Venezuelan population represented by the above sample is close enough to the one from the Canal Zone for the two to be grouped in one species. As there are only three Canal Zone specimens available for comparison, the differences between the two populations can not be discussed at length. Very likely the Canal Zone population will prove to average a higher dorsal count, to what extent remains to be seen.

Morphological relationship of the species of Garmannia.—Seven species of *Garmannia*,

TABLE 1.—FREQUENCY DISTRIBUTIONS OF THE FIN-RAY COUNTS IN GARMANNIA SCHULTZI AND G. SPES

Population	Sex	Pectoral					Dorsal			Anal			
		15	16	17	18	19	10	11	12	8	9	10	11
schultzi:													
Below Maracaibo City....	♂	—	2	12	5	1	—	10	9	—	3	16	—
	♀	—	1	8	5	—	—	11	2	1	3	9	—
Yacht Club.....	♂	—	—	4	—	—	—	3	1	—	—	4	—
	♀	—	—	1	1	—	—	2	—	—	—	2	—
Salina Rica.....	♂	—	1	4	—	—	—	5	—	—	1	4	—
	♀	—	—	1	1	—	—	2	—	—	1	1	—
spes:													
Venezuela.....	♂	21	29	2	—	—	1	32	19	—	9	42	1
	♀	12	39	4	—	—	1	35	19	—	10	44	1
Panama.....	♀	—	3	—	—	—	—	1	2	—	—	3	—
schultzi:													
Total.....	♂	—	4	20	5	1	—	19	10	—	4	25	—
	♀	—	1	10	7	—	—	15	2	1	4	12	—
Grand total.....		—	5	33	12	1	—	35	12	1	8	38	—
spes:													
Grand total.....		33	71	6	—	—	2	68	40	—	19	89	2

TABLE 2.—FREQUENCY DISTRIBUTION OF SCALE COUNTS IN MALES OF GARMANNIA SCHULTZI AND G. SPES

Population	Tranverse rows						Longitudinal rows				Number of scales behind pectoral		
	7	8	9	10	11	12	3	4	5	6	3	4	5
schultzi:													
Below Maracaibo City....	1	2	9	6	—	—	8	10	1	—	9	10	1
Yacht Club.....	—	—	4	—	—	—	—	1	3	—	2	2	—
Salina Rica.....	—	—	1	1	1	2	—	—	—	5	—	4	1
spes:													
Venezuela.....	—	5	16	15	2	1	2	10	24	1	21	28	3

TABLE 3.—FREQUENCY DISTRIBUTIONS OF SCALE COUNTS IN FEMALES OF GERMANNIA SCHULTZI AND G. SPES

Population	Transverse rows								Longitudinal rows					Number of scales behind pectoral				
	9	10	11	12	13	14	15	16	3	4	5	6	7	2	3	4	5	6
schultzi:.....																		
Below Maracaibo City.....	3	2	1	5	1	—	—	—	3	4	2	3	—	—	2	9	3	—
Yacht Club.....	—	—	—	—	1	1	—	—	—	—	1	1	—	—	—	1	—	1
Salina Rica.....	—	—	—	—	—	2	—	—	—	—	—	1	1	—	—	1	1	—
spes:																		
Venezuela.....	—	—	2	4	13	15	4	1	—	—	23	20	1	—	6	25	18	6
Panama.....	—	—	—	1	1	—	1	—	—	—	1	1	—	1	1	1	—	—

namely, *hildebrandi*, *spilota*, *spes*, *homochroma*, *pallens*, *gemmata*, and *mediocricula*, have been described by me at different times during the past four years. Two other species, *Gobius chiquita* Jenkins and Evermann and *Gobiosoma macrodon* Beebe and Tee-Van, generally placed in other genera by authors, should also be included in *Garmannia*. The above species together with *paradoxa*, the genotype, and the one here described, *schultzi*, constitute a total of 11 species now known, which are comprised within the limits of *Garmannia*. Other species hitherto placed by authors in *Garmannia* apparently should be transferred to other genera. (*Gobiosoma digueti* Pellegrin, inadequately described, the type of which is presumably in the Paris Museum and has not been examined by me, possibly also belongs to *Garmannia*.) It is, therefore, timely to give a short resume of the genus.

The 11 species of *Garmannia* show differences of varying degrees, some of them diverging widely in their morphological characters as compared with others. In order to display prominently the divergences for taxonomic purposes the genus may be divided into a number of subgenera, as follows:

Subgenus **Tigrigobius** Fowler

Tigrigobius Fowler, Proc. Acad. Nat. Sci. Philadelphia **83**: 401. 1931.

Genotype: *Garmannia macrodon* (Beebe and Tee-Van) = *Gobiosoma macrodon* Beebe and Tee-Van (Zoologica **10**: 226. 1928).

Besides the genotype, *pallens* is also referrable to *Tigrigobius*. This subgenus differs from all others in the dentition of the upper jaw. The outer row of teeth ends about midway between the symphysis and the angle of the mouth and the last tooth in the row is caninoid, appreciably larger than the teeth anterior to it. The maxillary is rather long, attaining approximately to the posterior margin of the eye. The head is strongly compressed. The squamation covers about the posterior third of the body in *pallens* and is reduced to a small patch on the caudal peduncle in *macrodon*. The color pattern is sharply cross-banded in *macrodon*, more moderately so in *pallens*.

Gobicula, n. subg.

Genotype: *Garmannia gemmata* Ginsburg (Smithsonian Misc. Coll. **98** (14): 3. 1939).

This monotypic subgenus is nearest to *Tigrigobius*, nearly agreeing with it in the backward extension of the maxillary and the head shape. It differs in the dentition of the upper jaw, which, as in the other subgenera, except *Tigrigobius*, has the teeth in the outer row extending nearly to the angle of the mouth and the posterior teeth are somewhat smaller than the anterior ones. The squamation is confined to the caudal peduncle. The cross-banded color pattern is obsolescent.

Gobiolepis, n. subg.

Genotype: *Garmannia hildebrandi* Ginsburg (JOURN. WASHINGTON ACAD. SCI. **29**: 62. 1939).

Besides the genotype, *chiquita* and *spilota* are also referable to *Gobiolepis*. This subgenus differs, in general, from the others, except *Gobiculina*, in the greater extent of squamation, although the division is not sharp when all the species are considered. The squamation on the midline extends all the way forward nearly to the pectoral base. In *hildebrandi* the anterior squamation, in the area anterior to the second dorsal, is much reduced, consisting largely of a rather narrow band of scales on the midline; in *chiquita* nearly the entire body is scaled over; while in *spilota* the squamation is about intermediate between that of the preceding two species. The maxillary ends under the posterior margin of the pupil or middle of eye. The head is depressed or subterete. The color pattern is diffusely cross-banded or no cross-bands are evident.

Subgenus **Garmannia** Jordan and Evermann

Garmannia Jordan and Evermann, Proc. California Acad. Sci. (2) **5**: 497. 1895.

Genotype: *Garmannia paradoxa* (Günther) = *Gobius paradoxus* Günther (Proc. Zool. Soc. London, 1861: 372).

Besides the genotype, *mediocricula*, which was described from two specimens in rather indifferent condition, probably also belongs to the subgenus *Garmannia*. This subgenus differs from all others, except *Gobiohelpis*, in having the fourth transverse row of cutaneous papillae on the cheek interrupted instead of continuous. The head and maxillary are about as in *Gobiolepis*. The squamation closely approaches that of *Gobiolepis*, but it is not quite so extensive. The posterior half of the body is scaled over; the anterior half is either naked or a median

row of nonimbricate or overlapping scales is present, sometimes a second incomplete row.

Gobiohelpis, n. subg.

Genotype: *Garmannia spes* Ginsburg (JOURN. WASHINGTON ACAD. SCI. **29**: 62. 1939).

This subgenus comprises *spes* and *schultzi*. It differs from all other subgenera in lacking a transverse row of scales on the caudal base. In other characters it nearly agrees with the subgenus *Garmannia*.

Gobiculina, n. subg.

Genotype: *Garmannia homochroma* Ginsburg (JOURN. WASHINGTON ACAD. SCI. **29**: 62. 1939).

This monotypic subgenus differs from all others in having a small barbel below the anterior nostril, a very long maxillary which extends somewhat behind the eye, at least in the male, and a markedly depressed head. The extent of squamation is about as in *Gobiolepis*.

Remarks.—The above is a brief outline of some of the characters, which omits for the sake of brevity some other pertinent but less well marked characters. There are apt to be differences of opinion regarding the taxonomic status of the subgenera established, depending on the prevalent taxonomic practice in different groups of living things, or on the ideas of individual taxonomists. According to usage now common in American ornithology, for instance, these subgenera should perhaps be raised to full generic rank, for the degrees of morphologic divergence between them is approximately of the same magnitude as that between closely related groups of species of birds, which are often recognized by American ornithologists as full genera. Also, according to the standards used by some individual ichthyologists the above subgenera should be treated as full genera. However, the essential object of displaying prominently the marked morphologic divergence between the groups of species is attained equally well by segregating them into subgenera as into full genera. On the other hand, convenience is best served by the taxonomic treatment here proposed of considering them as subgenera. In the practice of taxonomy it is much more convenient to have fewer and larger genera.

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